Portable dual-trace oscilloscope
PM3262

Instruction Manual/Gerätehandbuch/Notice d'emploi et d'entretien

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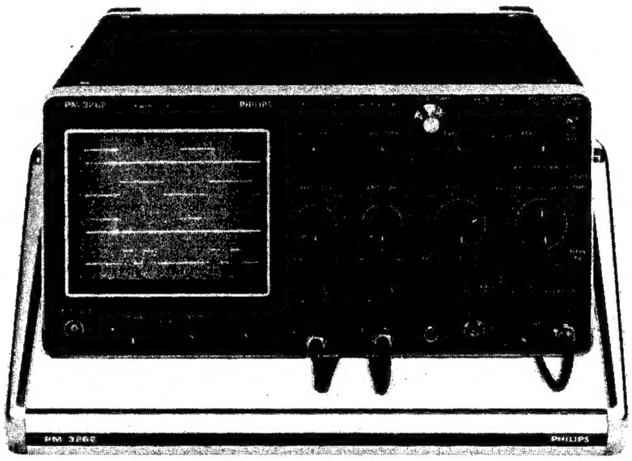

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PHILIPS

IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

WICHTIG

Bei Schriftwechsel über dieses Gerät wird gebeten, die genaue Typenbezeichnung und die Gerätenummer anzugeben. Diese befinden sich auf dem Leistungsschild.

IMPORTANT

RECHANGE DES PIECES DETACHEES (Réparations)

Dans votre correspondance et dans vos réclamations se rapportant à cet appareil, veuillez TOUJOURS indiquer le numéro de type et le numéro de série qui sont marqués sur la plaquette de caractéristiques.

Note: *The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.*

Bemerkung: *Die Konstruktion und Schaltung dieses Geräts wird ständig weiterentwickelt und verbessert. Deswegen kann dieses Gerät von den in dieser Anleitung stehenden Angaben abweichen.*

Remarques: *Cet appareil est l'objet de développements et améliorations continuels. En conséquence, certains détails mineurs peuvent différer des informations données dans la présente notice d'emploi et d'entretien.*

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1. GENERAL INFORMATION

1.1. INTRODUCTION

The PM 3262 Portable h.f. oscilloscope enables the measurement of signals at a sensitivity of 5 mV/DIV over an extensive bandwidth of 100 MHz (35 MHz at 2 mV/DIV). The oscilloscope is provided with many integrated circuits, which guarantee very stable operation and reduce the number of adjusting points. As an aid to checking and adjusting, testpoints have been included at appropriate positions around the circuit.

There is a wide choice of display possibilities, such as one channel, two channels alternately or chopped, two channels added, with normal and inverted positions for both input signals, and a main and delayed time-base. Additionally features of the PM 3262 are the 3rd channel TRIG VIEW and ALTernate TB facilities.
TRIG VIEW enables the display of the trigger signal (internal or external applied) via a 3rd channel by push-button selection. ALT. TB offers the instrument user a simultaneous display of the signal on the two time scales provided by the main time-base and by the delayed time-base.
The PM 3262 oscilloscope features a tapless power supply that covers two voltage ranges, 100 V to 127 V and 220 V to 240 V by means of a changeover link, thus obviating the need for continuous adjustment to the local mains voltage.
All these features make the oscilloscope suitable for a wide range of applications.

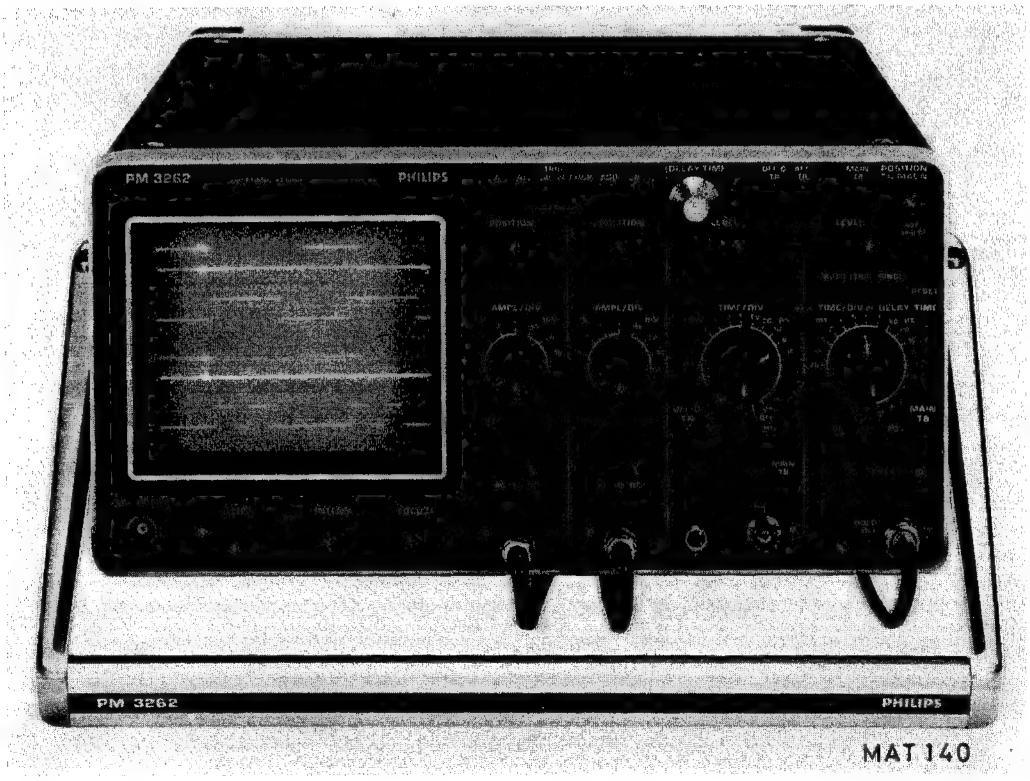

Fig. 1.1. Portable dual-trace oscilloscope PM 3262

1.2. CHARACTERISTICS

This instrument has been designed and tested in accordance with IEC Publication 348 for Class 1 instruments and has been supplied in a safe condition. The present Instruction Manual contains information and warnings that shall be followed by the purchaser to ensure safe operation and to retain the instrument in a safe condition.

This specification is valid after the instrument has warmed up for 30 minutes. Properties expressed in numerical values with tolerances stated, are guaranteed by the manufacturer. Numerical values without tolerances are typical and represent the characteristics of an average instrument.

	Designation	*Specification*	*Additional Information*
1.2.1.	**CRT**		
	Type	PHILIPS D14-300GH/37	Rectangular tube face, domed mesh type, post-accelerator, metal-backed phosphor
	Measuring area	80 x 100 mm	
	Screen type	P31 (GH) phosphor	P7 (GM) or P11 (BE) phosphor optional
	Photographic writing speed	> 1500 cm/µs	Typically 2000 cm/µs Measured with Steinheil Oscillophot M5 camera; aperture: 1:1,2 object-to-image ratio 1:0,5 film: Polaroid 410 (10.000 ASA) No pre-fogging Phosphor type P31 (GH)
	Total acceleration	17 kV	
	Graticule	Internal	Continuously variable illumination
	Engravings	Centimetre divisions with sub-divisions of 2mm along the central axes. Dotted lines at 1,5 and 6,5 div. from top of display provide measuring lattice for checking rise-time.	
	Trace rotation		Screw-driver adjustment available on front panel.
1.2.2.	**Vertical or Y axis**		
1.2.2.1.	*Response (2 mV range excepted)*	For 2 mV spec. see 1.2.2.14.	35 MHz at 2 mV
	Frequency range	d.c. to 100 MHz a.c. 10 Hz to 100 MHz	–3 dB bandwidth d.c. coupled –3 dB bandwidth a.c. coupled Frequency range includes 10:1 probe
	Rise-time	3,5 ns	
	Pulse aberrations	± 4 % peak-peak	Over 6 divisions, +5°C ... +40°C
1.2.2.2.	*Deflection coefficient*	2 mV/div ... 5 V/div	(for 2 mV spec. refer to Section 1.2.2.14.) Eleven calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1:2,5. Uncal. lamp signalling.
	Error limit	± 3 %	Except linearity of CRT.
	Maximum permissible input voltage	± 400 V	d.c. + a.c. peak. Derating at frequencies above 500 kHz. See Fig. 1.2.
	Maximum undistorted deflection	24 divisions	Up to 35 MHz
	Shift range	16 divisions	8 divisions each in upward and downward direction from the central horizontal line of graticule.

	Designation	*Specification*	*Additional Information*
1.2.2.3.	*Input impedance*	1 MOhm ± 2% // 15pF ± 10%	
	Input RC time	22 ms	Coupling to AC
1.2.2.4.	*Instability*		(for 2 mV/DIV setting refer to 1.2.2.14.).
	Instability of trace	0,1 div/hour	20-40 ^{o}C temperature range
	Trace jump	0,2 div	When switching between any of the attenuator positions
	Trace jump	0,5 div	When operating the NORM/INVERT switch
	Trace shift	0,2 div	When rotating the continuous attenuator 0,4 div in 5 mV setting
	Trace shift	0,5 div	When switching to the ADDED position. 1 div in 5 mV setting. Increasing when rotating the continuous attenuator.
1.2.2.5.	*Short-term temperature drift*	As 1.2.2.6.	
1.2.2.6.	*Long-term temperature drift*	$4x10^{-3}$div./k	Typical value
1.2.2.7.	*Visible signal delay*	15 ns	Typical value
1.2.2.8.	*Display modes*	Channel + or − A only Channel + or − B only Trig. view only Channels ± A and ± B chopped Channels ± A and ± B alternated Channels ± A and ± B added ± A, ± B and Trig. view chopped or alternated (3 channels display)	If trigger view is selected in combination with alternate time-base display, this will be automatically displayed in main time-base intensified mode. Refer to 1.2.2.12. for full trig. view specification.
1.2.2.9.	*Chopper frequency*	1 MHz	Display time per channel 350 ns approx.
1.2.2.10.	*Cross-talk between channels*	1:500	With 8 divisions of signal amplitude on one channel, cross talk on other channel within line width, up to 35 Mc. Both attenuators in the same setting.
1.2.2.11.	*Common mode rejection factor*	Better than 100 up to 2 MHz 20 at 50 MHz	Measured with +A and −B added. Max. common-mode signal 8 divisions.
1.2.2.12.	*Trigger view display*	External or internal trigger signal.	
	Frequency range	0 Hz ...... 80 MHz.	
	Deflection coeff.	Same as vertical	
	External	100 mV/div ± 3 %	
	External ÷ 10	1 V/div ± 5 %	
	Internal	Vertical ± 10 %	
1.2.2.13	*Trigger point*	Screen centre ± 0,3 div	
	Aberrations	± 10 % peak-to-peak	
	Time delay between vertical input and external input	3 ns ± 1 ns	

	Designation	Specification	Additional Information
1.2.2.14.	*Specification of 2 mV/div setting*		
	a. Deflection coeff.	2 mV/div	
	Error limit	± 5 %	
	b. Response		
	Frequency range	DC 0 ... 35 MHz	–3 dB
		AC 7 Hz ... 35 MHz	–3 dB
	Rise time	10 ns	
	Pulse aberation	± 5 % peak-to-peak	
	Common mode rejection factor	Better than 100 up to 2 MHz	
	c. Instability		
	Instability of trace	0,25 div/hour	20-40 °C temperature range
	Trace jump	2 div	When switching from 5 mV to 2 mV attenuator position
	Trace jump	2 div	When operating the Normal/Invert switch
	Trace shift	1 div	When rotating the continuous attenuator
	Trace shift	1 div	When switching to ADDED position
1.2.3.	**Horizontal or X Axis**		
1.2.3.1.	*Displays modes*	– Main time-base	
		– Main time-base intensified by delayed time-base	
		– Delayed time-base	
		– Main TB intensified and delayed TB alternately displayed.	With possibility of trace separation of 4 divisions. Not applicable if trigg. view is combined with channel A or B
		– X-Y and X-Y/Y operation	X deflection by: – channel A signal – channel B signal – signal applied to EXT connector of main TB – line voltage
1.2.3.2.	*Horizontal position drift in X1 position*	0,2 div/hour	The horizontal position drift with the magnifier in the X1 position, shall not exceed 0,1 div/hour over 20-40 °C temperature range. The same stability requirement applies to the start of the sweep during variation of the sweep speed setting, with exception of highest sweep ranges (50-100 ns/div).
1.2.3.3.	*Horizontal position control*	± 5,2 div from screen centre	The horizontal shift control combines coarse and fine adjustment.
1.2.4.	**Main Time-base**		
1.2.4.1.	*Operation*	Automatic	Automatic free running in the absence of triggering signals, after less than 0,1 sec.
		Triggered	100 m sec.
		single shot	Not triggered lamp is burning after reset and extinguishes at the end of the sweep.

	Designation	Specification	Additional Information
1.2.4.2.	*Time coefficient*	1 s/div ... 50 ns/div	23 calibrated positions in a 1-2-5 sequence Uncalibrated continuous control 1:>2,5 between the steps. One uncal. lamp for both MTB and DTB.
1.2.4.3.	*Coefficient error*	± 2 % ± 3 %	+20 °C ... +30 °C + 5 °C ... +40 °C The difference in sweep accuracy over any two divisions of the sweep is ± 5%
1.2.4.4.	*Expansion*		
	Magnification	10x	Switched, calibrated. The display which coincides with the central vertical graticule line shall not shift more than one div when the horizontal magnifier is changed from X1 to X10.
	Coefficient error	± 1 % additional	Exclude first and last 50 ns of 5 ns/div, 10 ns/div, 20 ns/div and 50 n sec/div. magnified sweep rates
	Max. effective time coefficient	5 ns/div	
1.2.4.5.	*Variable hold-off time*	The sweep hold-off time can be increased by a factor of 10.	
1.2.5.	**Delayed Time base**		
1.2.5.1.	*Operation*	Delayed time-base starts optionally either immediately after the delay time, or upon arrival of the first trigger pulse after the delay time.	
1.2.5.2.	*Comparator long-term stability*	< 2 div at 1000 times magnification	With MTB at 1 ms/div and DTB at 1 μs/div a selected signal detail in the DTB mode shall not move more than two divisions after warm-up
1.2.5.3.	*Time coefficient*	0,5 s/div ... 50 ns/div	22 calibrated positions in 1-2-5 sequence Uncalibrated continuous control 1:> 2,5 between the steps. One uncal. lamp for both MTB and DTB.
1.2.5.4.	*Coefficient error*	± 2 % ± 3 %	+20 °C ... +30 °C + 5 °C ... +40 °C The difference in sweep accuracy over any two divisions of the sweep is ± 5%,
	Expansion	see 1.2.4.4.	

	Designation	Specification	Additional Information
1.2.5.5.	*Delay-time*	Continuously variable between 0x and 10x the time coefficient of the MTB	Calibrated. Range delay-time multiplier 0,00-9,99 Incremental accuracy 0,5 % typical 0,2 %.
1.2.5.6.	*Delay-time jitter*	Better than 1:30.000	
1.2.6.	**X Deflection**		
	X deflection via channel Y_A or Y_B	2 mV/div ... 5 V/div	Uncalibrated continuous control 1:2,5 via Y gain potentiometer.
1.2.6.1.	*Coefficient error*	± 5 %	
1.2.6.2.	*Bandwidth*	0 - 2 MHz	–3 dB bandwidth over 4 div.
1.2.6.3.	*Maximum undistorted delfection*	20 divisions	up to 100 kHz
1.2.6.4.	*Phase difference with respect to Y display*	3° at 100 kHz	
	External X-deflection via EXT socket		
1.2.6.5.	*Deflection coefficient*		
	External External ÷ 10	50 mV/div 500 mV/div	Uncalibrated continuous control 1:3
1.2.6.6.	*Accuracy*		
	External	± 3 %	Additional 2 % for Ext. :10
1.2.6.7.	*Bandwidth*	d.c. ... 2 MHz 7 Hz ... 2 MHz	Via DC trigg. coupling via LF or HF trigg. coupling
1.2.6.8.	*Input impedance*	1MΩ ±2% // 15 pF ± 10%	
1.2.6.9.	*Phase difference Y-channels*	3° at 100 kHz	
1.2.6.10.	*Linearity*	1,5 %	
1.2.6.11.	*Drift*	0,2 div./hr.	
1.2.7.	**Triggering of the main time-base**		
1.2.7.1.	*Trigger source*	Internal from channel A Internal from channel B Composite A and B Internal from line External source External source ÷ 10	 Alternate vertical mode only
1.2.7.2.	*Trigger modes*	Automatic	Automatic free-run of the time-base generator approx. 100 ms after disappearance of the trigger signal.
		Trigg. single sweep	NOT TRIG'd lamp is illuminated after reset and extinguishes at the end of the sweep.
1.2.7.3.	*Slope*	+ or –	

	Designation	Specification	Additional Information
1.2.7.4.	*Trigger sensitivity*	Internal better than 0,5 div. up to 30 MHz 1,5 div. up to 100MHz	Typical sensitivity as a function of frequency, see fig. 1.3a.
		External 50 mV up to 30 MHz 150mV up to 100MHz	Typical sensitivity as a function of frequency see fig. 1.3b.
		External ÷ 10 0,5V up to 30 MHz 1,5V up to 100MHz	
1.2.7.5.	*Filter bandwidth*	DC: 0 - full bandwidth LF int: 0 - 30 kHz LF ext: 7 Hz - 30 kHz HF: 30 kHz - full bandwidth	Both internal and external Both internal and external
1.2.7.6.	*Level range*		
	internal trigg. external trigg. external : 10	24 DIV +1,2V to −1,2V +12V to −12V	
1.2.7.7.	*Input impedance*	1 MOhm ± 2% // 15 pF ± 10%	
1.2.7.8.	*Trigger jitter*	Better than 0,5 ns	
1.2.8.	**Triggering of the delayed time-base**		
1.2.8.1.	*Source*	Internal from channel A Internal from channel B External	Other characteristics are identical to TRIGGERING OF THE MAIN-TIME BASE. Except Ext. :10 and line trigg.
1.2.9.	**Calibration unit**		
1.2.9.1.	*Output voltage*	3 V_{p-p}	
1.2.9.2.	*Output current*	6 mA	
1.2.9.3.	*Error limit*	± 1 %	Both voltage and current
1.2.9.4.	*Frequency*	2 kHz ± 2 %	
1.2.9.5.	*Protection*	The output is protected against continuous short-circuiting.	
1.2.10.	**Rear inputs**		
1.2.10.1.	*Z-modulation*	DC coupled TTL compatible "High" Level Blanks display response time 35 ns input impedance 10 kΩ max. input voltage 50 V	

	Designation	*Specification*	*Additional Information*
1.2.11.	**Power supply**		
1.2.11.1.	*Line voltages*	100-127 Va.c. ± 10 % 220-240 Va.c. ± 10 % 250 Vd.c. ... 350 Vd.c.	Automatically protected against incorrect setting of line selector
1.2.11.2.	*Line frequency*	46 to 440 Hz	
1.2.11.3.	*Power consumption*	50 W	
1.2.11.4.	*Power transients*		Damage to the oscilloscope shall not occur under voltage and frequency transient conditions specified in MIL-T-28800.

1.2.12. Environmental characteristics

Note:

The characteristics are valid only if the instrument is checked in accordance with the official checking procedure. Details on these procedures and failure criteria are supplied on request by the PHILIPS-organisation in your country, or by N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, THE NETHERLANDS.

1.2.12.1. Temperature tests

In accordance with IEC 68 Ab and Bb.
Operation: – 10°C to +55°C. .
Operation within specification: +5 °C to +40 °C. Exceptions on tolerances to be indicated per spec. point.
Storage: –55 °C to +75 °C.

1.2.12.2. Altitude

In accordance with IEC 68-2-13 test M.
Operation: to 5000m.
Derating : 1k/330m for the max. operating temperature
Storage : to 15000m.
Humidity
In accordance with IEC 68Db following standard PHILIPS oscilloscope test program, also comparison with Mi L-E-1640F 5 cycles (120 hours) has to be made.

1.2.12.3. Shock

Operating: 30 g, half-sine, 11 ms duration, 2 shocks per axis per direction for a total of 12 shocks.

1.2.12.4. Vibration

Operating: 15 minutes along each of 3 axes.
635 μm p-p displacement (4g at 55Hz) with frequency varied from 10 Hz to 55Hz to 10Hz in one minute cycles.

1.2.12.5. Recovery

Operates within 30 minutes coming from –10 °C soak, going into room condition of 60 % R.H. at 20 °C.

1.2.12.6. Magnetic Shielding

In accordance with IEC 351 - 22.3.1.
A maximum deviation of 1 div.

1.2.12.7. Interference

VDE 0871 and 0875, Grenzwert class B

1.2.13. Mechanical data

1.2.13.1.	*Dimensions*	Length	410 mm (16 1/4 inch). Excluding controls, cover and feet
		Width	316 mm (12 1/4 inch).
		Height	154 mm (6 1/8 inch).
1.2.13.2.	Weight	Weight	9,6 kg (21 lbs).

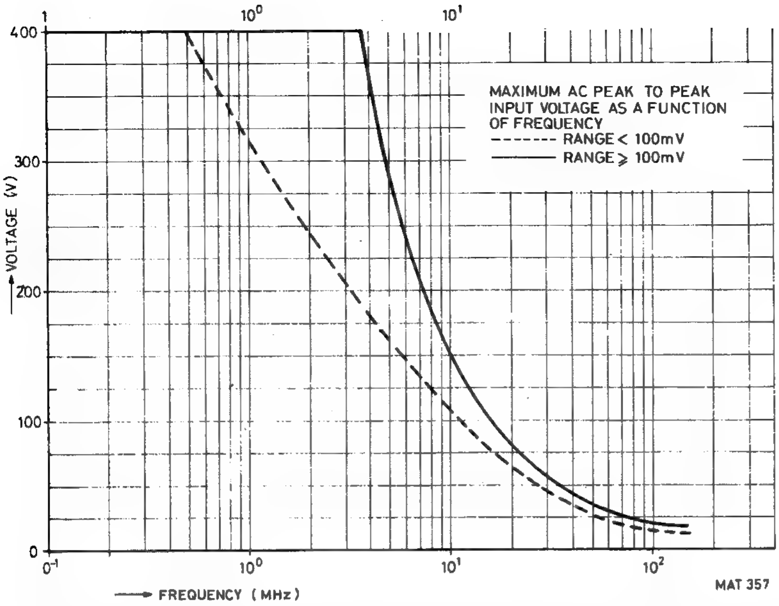

Fig. 1.2. Derating of the maximum permissible input voltage as a function of requency

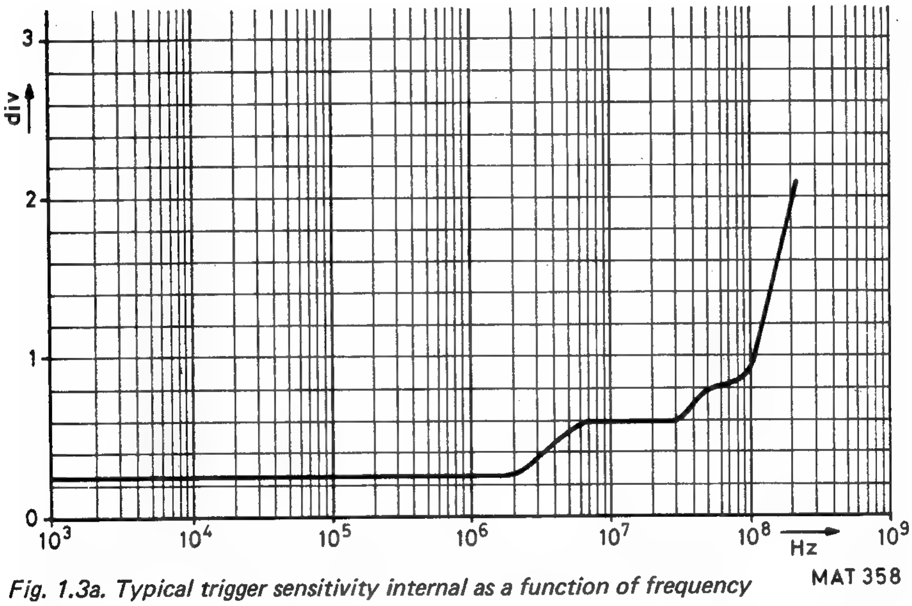

Fig. 1.3a. Typical trigger sensitivity internal as a function of frequency

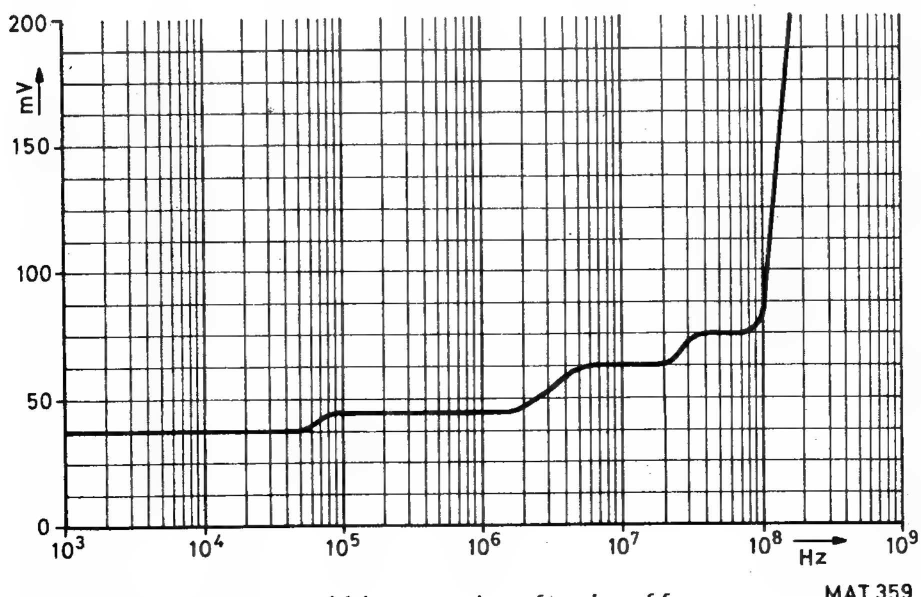

Fig. 1.3b. Typical trigger sensitivity external as a function of frequency

1.3. ACCESSORIES

1.3.1. Accessoires delivered with the instrument

- Two passive 10:1 probes
- Contrast filter
- Front cover with storage space
- Collapsible viewing hood (PM9366)
- Banana - BNC adapter (PM9051)
- CAL terminal - BNC adapter
- Manual

1.3.2. Optional accessoires

PM 8901/02	Battery pack 24V d.c. and 330V d.c.
PM 8910	Polaroid anti-glare filter
PM 8921	Passive probe set 1:1 (1.5m)
PM 8921L	Passive probe set 1:1 (2.5m)
PM 8932	Passive probe set 100:1
PM 8935	HF passive probe set 10:1 (1.5m)
PM 8935L	HF passive probe set 10:1 (2.5m)
PM 8940	Isolation amplifier
PM 8960	19 inch rack mount adaptor
PM 8971	Adapter for oscilloscope camera
PM 8980	Long type viewing hood.
PM 8991	Oscilloscope trolley
PM 8992	Accessory pouch
PM 8994	Set of accessories for probes
PM 9343	Active FET probe
PM 9355	Current probe: 1 mA/div ... 1 A/div.; 12 Hz ... 70 MHz
PM 9380	Oscilloscope camera
800/NTX	Trimming tool kit

Fig. 2.1. Removing front cover

Fig. 2.2. Rear view of the instrument

2. OPERATING MANUAL

2.1. GENERAL INFORMATION

This section outlines the procedures and precautions necessary for installing the PM 3262, identifies and briefly describes the functions of the front and rear panel controls and indicators, and explains the practical aspects of operation to enable an operator to evaluate quickly the instrument's main functions.

2.1.1. Installation

Before any other connection is made, the protective earth terminal shall be connected to a protective conductor (see section EARTHING).

WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals, which can be dangerous to life.

The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair is effected with the instrument open. If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a skilled person who is aware of the hazard involved. Bear in mind that the capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

2.1.2. Removing and fitting the front cover (see Fig. 2.1.)

Removing:
- Rotate the knob in the centre of the cover a quarter-turn anti-clockwise to UNLOCKED position.
- Remove the cover

Fitting:
- Rotate the knob to the UNLOCKED position
- Fit the cover over the front of the oscilloscope.
- Press and rotate the knob a quarter-turn clock-wise to LOCKED position.

Note: The handle can be rotated if the push-buttons on its bearings are depressed.

2.1.3. Mains adjustment and fuse

The ability of the instrument to operate at any mains voltage between 100 V and 127 V (with mentioned voltage rate on CIRCUIT BREAKER visible) and between 220 V and 240 V (link reversed) (also visible through the window at the rear), obviates the need to adapt the instrument to the local mains, once the relevant supply range has been established.

The fuse-holder, which is mounted on the rear panel, carries a 2 A delayed action fuse. Ensure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse-holders shall be avoided. This instrument shall be disconnected from all voltage sources when a fuse is to be replaced.

Note: For the setting 100 V ... 127 V as well as the setting 220 ... 240 V the same 2 A delayed action fuse is used.

2.1.4. Earthing

Before switching on, the instrument shall be connected to a protective earth conductor in one of the following ways:

- via the protective earth terminal at the rear (identified by the symbol ⏚);
- via the earth wire in three-core mains cable.

The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension cord without protective conductor. Replacing the mains plug is at the user's own risk.

WARNING: Any interruption of the protective conductor inside or outside the instrument, or disconnection of the protective earth terminal is likely to render the instrument dangerous. Intentional interruption is prohibited.
When an instrument is brought from a cold to a warm environment, condensation may cause a hazardous condition. Ensure, therefore, that the earthing requirements are strictly adhered to.

2.1.5. Switching on

The POWER switch is incorporated in the graticule ILLUM control on the front panel, immediately below the screen bezel. The associated POWER ON/OFF indicator lamp is adjacent to the ILLUM control.
The oscilloscope must never be switched on whilst any circuit board is removed.
Never remove a circuit board until the oscilloscope has been switched off for at least one minute.

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2.2.1.

2.2.1.1.

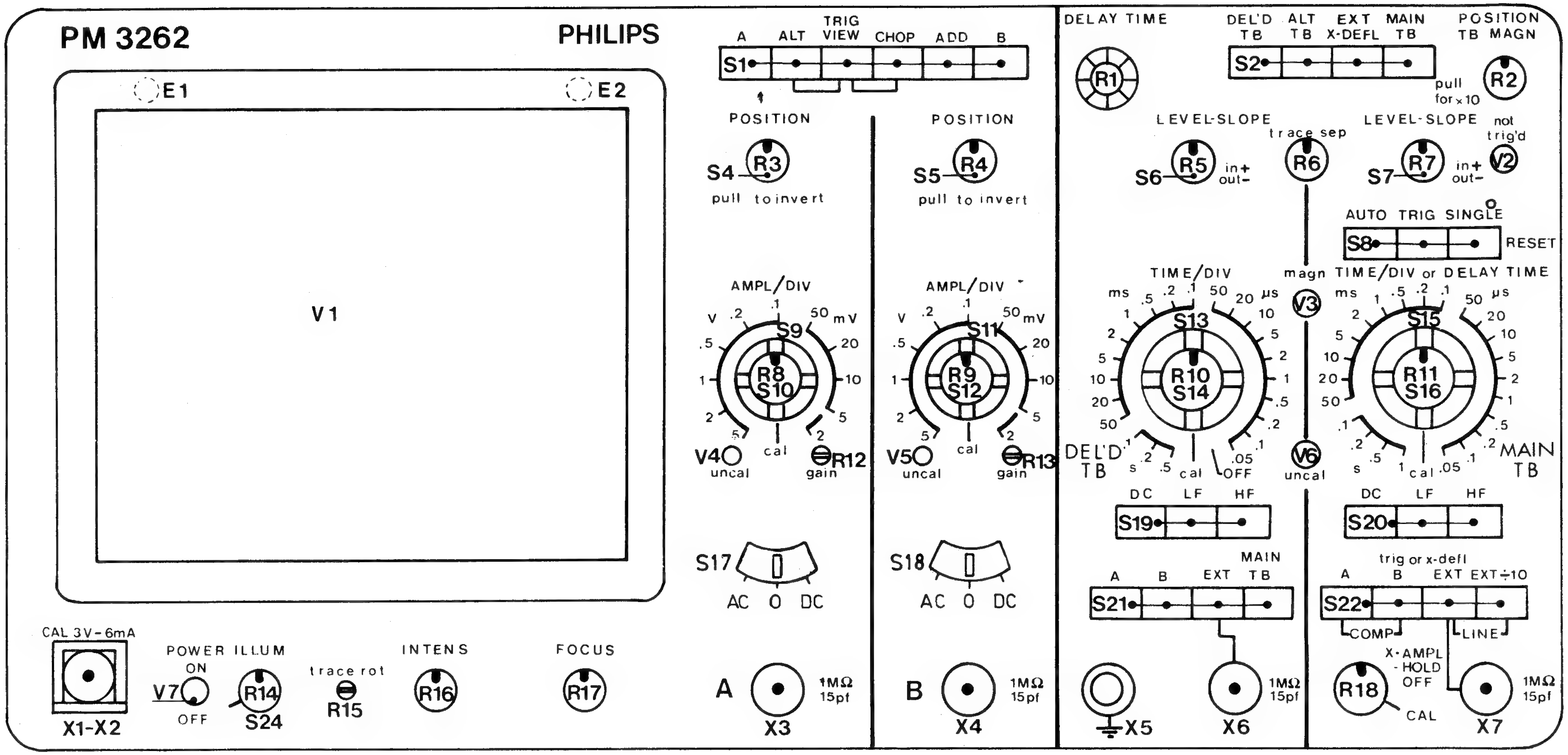

Fig. 2.3. Front view showing controls and sockets
Abb. 2.3. Vorderansicht mit Bedienungsorganen und Buchsen
Fig. 2.3. Vue avant montrant les commandes et douilles

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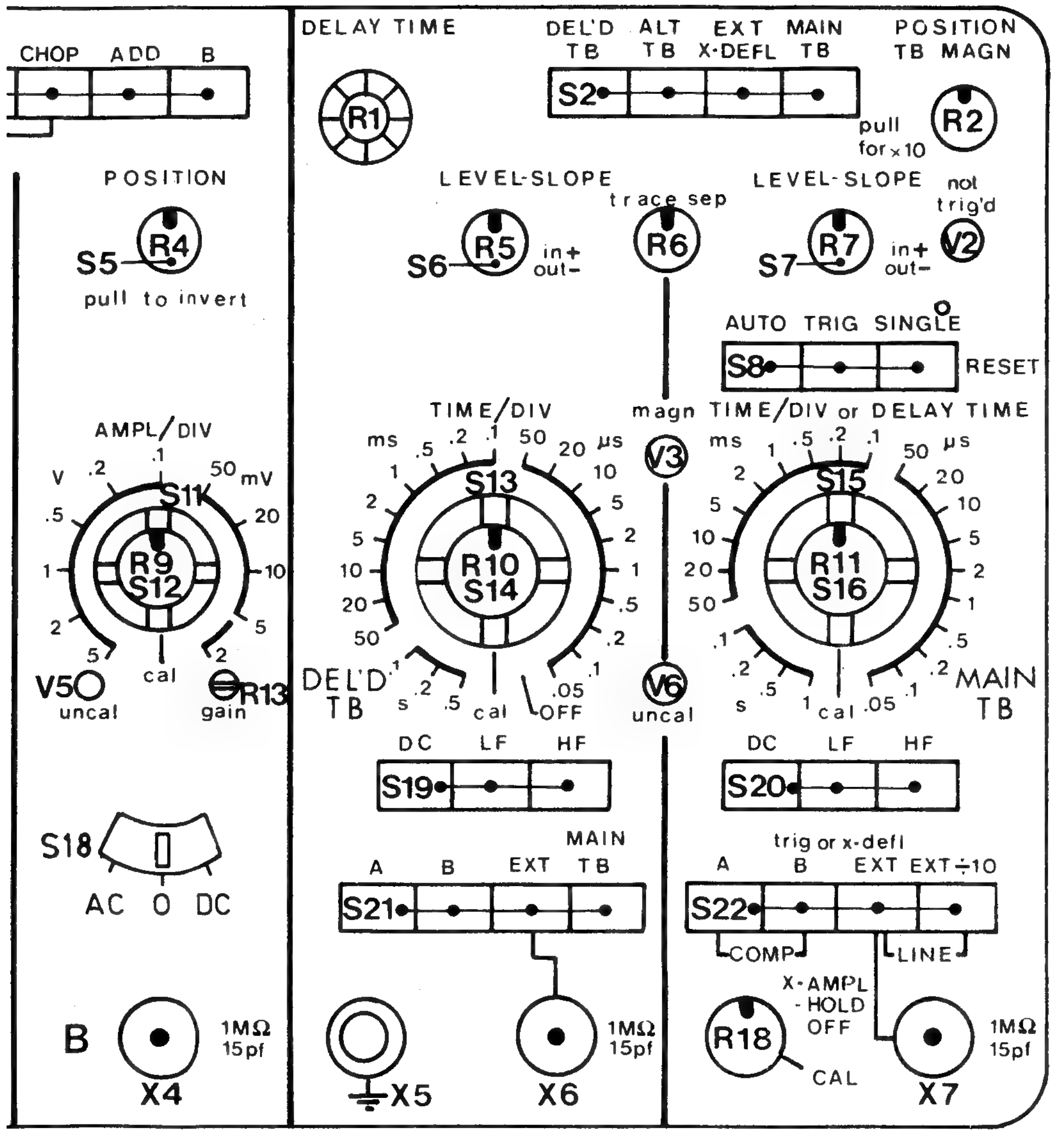

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2.2. OPERATING INSTRUCTIONS

Before switching on, ensure that the oscilloscope has been correctly installed in accordance with section 2.1. INSTALLATION and that the precautions outlined have been observed.

2.2.1. Controls and sockets (Fig. 2.3.)

2.2.1.1. Vertical channels

A, ALT, TRIG VIEW, CHOP, ADD, B (S1)	Vertical display-mode controls; 6-way push-button switch.
A depressed	Vertical deflection is achieved by the signal connected to the input of channel A.
ALT depressed	The display is switched over from one vertical channel to the other at the end of every cycle of the time-base signal; i.e. the A and B channels are displayed on ALTernate sweeps.
TRIG VIEW depressed	The display is switched to view the selected trigger signal. Trigger view display can be internal via A or B channels (A or B of S22 depressed) or external via external input socket X7, when EXT or EXT ÷ 10 of S22 is depressed.
CHOP depressed	The display is switched over from one vertical channel to the other at a fixed frequency, both A and B channels being displayed during the same sweep.
ADD depressed	Vertical deflection is achieved by the sum signal of channels A and B.
B depressed	Vertical deflection is achieved by the signal connected to the input of channel B.
All pushbuttons normal	If no push-button is depressed, the instrument operates in the ALT mode.
ALT and TRIG VIEW depressed simultanuously	The signals on channels A, B and TRIG VIEW are displayed during alternate sweeps; usually suitable for high frequency signals (see also explanation of push-button TRIG VIEW)
CHOP and TRIG VIEW depressed simultaneously	The signals on channel A, B and TRIG VIEW are displayed one after the other at the CHOP frequency during the same sweep; usually suitable for low frequency signals. (See also explanation of push-button TRIG VIEW)
POSITION (R3, R4)	Continuously variable control giving vertical shift of the display.
PULL TO INVERT (S4, S5)	2-way push-pull switch, integral with the POSITION control, for the inversion of the signal polarity. Control is depressed for NORMAL and pulled for INVERT.
AMPL/DIV (S9, S11)	Step control of the vertical deflection coefficients; 11-way switch.
CAL (AMPL/DIV) (R8/S10, R9/S12)	Continuously variable control of the vertical deflection coefficients. In the CAL position the selected deflection coefficient is calibrated
UNCAL (V4, V5)	Pilot lamp indicating that the CAL control is not in the CAL position.
GAIN (R12, R13) (screw-driver control)	Continuously variable preset control of the overall gain of the vertical channels.

AC, 0, DC (S17, S18)	Signal input coupling; 3-way push-button switch.
AC	Coupling via a blocking capacitor
0	Connection between input circuit and input socket is interrupte and the amplifier input is earthed to establish a reference.
DC	Direct coupling When viewing long duration pulses or d.c. levels of waveforms, the DC position should be selected. For a.c. waveforms with large d.c. levels, the AC position should be selected.
A, 1 MΩ//15 pF (X3)	BNC input socket for channel A.
B, 1 MΩ//15 pF (X4)	BNC input socket for channel B.

2.2.1.2. Horizontal channels

DEL'D TB, ALT TB, EXT X DEFL, MAIN TB (S2)	Horizontal displaymode or deflection controls; 4-way push-button switch.
DEL'D TB depressed	The horizontal deflection voltage is supplied by the delayed time-base generator.
ALT TB depressed	The horizontal display is switched over from the main time-base to the delayed time-base at the end of every cycle of the main time-base generator. Not functioning when TRIG VIEW is depressed or when the delayed time-base is switched to OFF.
EXT X DEFL depressed	Horizontal deflection is achieved by a signal applied to the external input socket (X7) of the horizontal amplifier, by the channel A or B signals, the composite signal, or by a mains-frequency (LINE) signal, depending on the TRIG or X DEFL push-button (S22) selection.
MAIN TB depressed	The horizontal deflection voltage is supplied by the main time-base generator. A part of the trace is intensified (except in the OFF position of the TIME/DIV switch of the delayed time-base generator). **No push-button depressed** is effectively the same as MAIN TB depressed.
POSITION TB MAGN (R2, S3)	Continuously variable control giving horizontal shift of the display; incorporates a push-pull switch for increasing the horizontal deflection coefficient by a factor of 10 (PULL FOR X10).
MAGN (V3)	A pilot lamp indicating that the X10 magnifier is in operation.
X-AMPL, HOLD-OFF (R18)	Continuously variable control of the horizontal deflection coefficients when using external X deflection. In the case of X deflection by the main time-base, this control can be used to increase the sweep hold-off time.
TRACE SEP. (R6);	Continuously variable preset control of the vertical space between the two time-base displays in the ALT TB mode.

2.2.1.3. Main time-base generator

LEVEL-SLOPE (R7, S7)	Continuously variable control for selecting the level of the triggering signal at which the time-base generator starts. This control incoporates a push-pull switch that enables choice of triggering on either the positive- or negative-going edge of the triggering signal (IN +, OUT −).
NOT TRIG'D (V2)	Pilot lamp indicating that the time-base generator is in the waiting position.

AUTO, TRIG, SINGLE (S8)	Trigger-mode controls; 3-way push-button switch.
AUTO depressed	The main time-base is free-running in the absence of trigger signals.
TRIG depressed	The time-base generator is normally triggered.
SINGLE depressed	After depressing the SINGLE button, the time-base generator runs only once upon receipt of a trigger pulse. If no button is depressed the circuit operates effectively as if the SINGLE mode has been selected.
TIME/DIV or DELAY TIME (S15)	Time coefficient control of the main time-base; 23-way rotary switch.
CAL (blue) - TIME/DIV (R11, S16)	Continuously variable control of the main time-base coefficients. In the CAL position the time coefficient is calibrated.
UNCAL (V6)	Pilot lamp indicating that the CAL control is not in the calibrated position.
DC, LF, HF (S20)	Trigger coupling; 3-way push-button switch.
DC depressed	Triggering signals are direct-coupled.
LF depressed	Trigger coupling via low-pass filter for frequencies up to 30 kHz (for external triggering via band-pass filter of 10 Hz to 30 kHz).
HF depressed	Trigger coupling via a high-pass filter for frequencies higher than 30 kHz. With no push-button depressed, the circuit operates effectively as with the DC button depressed.
TRIG or X-DEFL (S22)	Trigger source or external X deflection selector; 4-way push-button switch. X-deflection only when push-button EXT X DEFL of S2 (horizontal display-mode controls) is depressed.
A depressed	Internal triggering or X deflection signal derived from channel A.
B depressed	Internal triggering or X deflection signal derived from channel B.
COMP (A and B depressed simultaneously)	Internal triggering or X deflection signal derived from channels A and B.
EXT	Triggering on external signal connected to the adjacent 1MΩ, 15 pF socket (X7). When the EXT X DEFL button of the horizontal deflection controls is depressed, this socket is connected to the input of the horizontal amplifier.
EXT ÷ 10	EXT triggering or X deflection facilities as above, attenuated by a factor of ten.
LINE (EXT and EXT ÷ 10 depressed simultaneously)	Triggering or X deflection signal derived from an internal voltage at mains frequency. If no button is depressed, no mode is selected.
1 MΩ//15 pF (X7)	BNC socket for external triggering or horizontal deflection

2.2.1.4. *Delayed time-base generator*

DELAY TIME MULTIPLIER (R1)	Continuously variable control of the delay time, operating in conjunction with the TIME/DIV controls of the main time-base generator.
LEVEL-SLOPE (R5, S6)	Continuously variable control for selecting the level of the triggering signal at which the delayed time-base generator starts.

	This control incorporates a push-pull switch that enables choice of triggering on the positive or negative-going edge of the triggering signal (IN +, OUT –).
TIME/DIV (S13)	Time-coefficient control of the delayed time-base; 23-way rotary switch. Incorporates an OFF position whereby the delayed time-base is switched off.
CAL (blue) - TIME/DIV (R10, S14)	Continuously variable control of the delayed time-base generator time coefficients. In the CAL position the time coefficient is calibrated.
UNCAL (V6)	Pilot lamp indicating that the CAL control is not in the calibrated position.
DC, LF, HF (S19)	Trigger coupling; 3-way push-button switch.
DC depressed	Triggering signals are direct-coupled.
LF depressed	Trigger coupling via low-pass filter for frequencies up to 30 kHz (for external triggering via band-pass filter of 10 Hz to 30 kHz).
HF depressed	Trigger coupling via a high-pass filter for frequencies higher than 30 kHz.
	With no push-button depressed, the circuit operates effectively as with the DC button depressed.
A, B, EXT, MAIN TB (S21)	Trigger source control and starting point of delayed time-base 4-way push-button switch.
A depressed	Internal triggering signal derived from channel A after delay time.
B depressed	Internal triggering signal derived from channel B after delay time.
EXT depressed	Triggering after delay time on an external signal connected to the adjacent 1 MΩ, 15 pF socket
MAIN TB depressed	Delayed time-base starts immediately after delay time.
	With no button depressed, the circuit operates effectively as with the MAIN TB button depressed.
1 MΩ//15 pF (X6)	BNC input socket for external triggering signals.

2.2.1.5. Cathode-ray tube

ILLUM, POWER ON (R14, S24)	Continuously variable control of the graticule illumination incorporating the mains ON/OFF switch.
POWER ON (V7)	Pilot lamp indicating that the instrument is switched on.
INTENS (R16)	Continuously variable control of the trace brilliance.
FOCUS (R17)	Continuously variable control of the c.r.t. electron-beam focusing.
TRACE ROT (R15); (screw-driver control)	Preset control for aligning the trace with the graticule line.

2.2.1.6. Miscellaneous

CAL (X1, X2)	Output socket providing a 2 kHz square-wave voltage of $3V_{p-p}$ at a current of 6 mA for calibration purposes.
⏚ (X5)	Measuring earth socket
Z-MOD (X8) at rear side	Input socket for external Z-modulation.

2.2.2. Preliminary settings

As the following settings are identical for both vertical channels, only the procedure for channel A has been indicated.
Unless otherwise stated, the control occupy the same position as in the previous adjusting procedure.

2.2.2.1. *Adjusting the gain*

- Operate push-button A of the display-mode controls (S1)
- Operate push-button A of the trigger-mode selector switch (S22)
- Operate push-button AUTO of the trigger-mode controls (S8)
- Operate push-button MAIN TB of the horizontal deflection controls (S2)
- Display the trace by means of the A POSITION control
- Set the INTENSity and FOCUS controls for a sharp, well-defined trace
  The controls not mentioned may occupy any position.
- Set the channel A AC-0-DC switch to DC
- Set the channel A AMPLitude switch to 0.5 V and the continuous control to CALibrated
- Connect the CALibration socket to the A input socket.
- Check that the trace height is exactly 6 divisions.
  If necessary, readjust the GAIN control on the front panel, immediately below the AMPLitude switch.

2.2.3. Inputs A and B and their possibilities

The oscilloscope has been provided with two identical channels, each of which can be used for either YT measurements in combination with one or both time-base generators, or XY measurements in combination with the external horizontal channel.

2.2.3.1. *YT measurements*

To display one signal, one of the two vertical channels can be selected by operating either push-button A or push-button B of the vertical display-mode controls.
When push-button ALT or CHOP is depressed, two different signals can be displayed simultaneously. The Y deflection coefficient and the polarity can be selected for each channel individually. When the ALT button is operated, the display is switched over from one channel to the other at the flyback of the time-base signal. Although the ALTERNATE mode can be used at all sweep speeds of the time-base generator, the CHOPPED mode will give a better display quality for long sweep times, because during these long sweep times the alternate display of the two input signals is clearly visible to the eye.

In the CHOPPED mode, the display is switched over from one channel to the other at a fixed frequency.
If push-button ADD of the display mode switch is operated, the signal voltages of both vertical channels are added. Depending on the positions of the polarity switches, either the sum or the difference of the input signals is displayed. The ADDED mode also enables differential measurements. With these measurements advantage is taken from the common mode rejection in the ADDED position. When the polarity switches of both channels are set to opposite positions, the common mode parts of the signals on sockets A and B will undergo a very slight amplification only, with respect to the differential mode parts.

2.2.3.2. *XY measurements*

If push-button EXT X DEFL S2 of the horizontal display-mode (selection) controls and one of the TRIG OR X DEFL controls are operated, the time-base generator are switched off. If for example push button A of S22 is depressed, a signal applied to the vertical A channel is then used for horizontal deflection. The AC/0/DC switch and the step attenuator of channel A remain operative. Horizontal trace shift is possible with the X POSITION control and continuous control of the deflection coefficients with the A AMPL/DIV control.
Vertical channel B may also be used for X deflection.
To this end, the B button of the TRIG OR X DEFL controls is depressed.

It is also possible to use an internal voltage at the mains frequency or a signal applied to the EXT socket at the bottom right-hand side of the front panel for X deflection, after depressing the relevant push-button of the TRIG OR X DEFL controls. In the EXT and EXT ÷ 10 modes the trace width can be controlled with the X-AMPL/HOLD OFF potentiometer.
With this potentiometer in its CAL position, the deflection coefficient for external signals is 50 mV/DIV.
The external signal can be either d.c. or a.c. coupled (lower frequency limit 10 Hz) by depressing either the DC or the LF push-button of the trigger coupling controls of the main time-base.

2.2.3.3. AC/0/DC switch

The signals under observation are fed to input socket(s) A and/or B and the AC/0/DC switch is set to either AC or DC, depending upon the composition of the signal. As the vertical amplifier is d.c. coupled, the full bandwidth of the instrument is available and d.c. components are displayed as trace shifts in the DC position of the AC/0/DC switch.
This may be inconvenient when small signals superimposed on high d.c. voltages must be displayed. Any attenuation of the signal will also result in attenuation of the small a.c. component. The remedy is to use the AC position of the input switch, which employs a blocking capacitor, to suppress the d.c. and l.f. signals.
Some pulse drop will occur when l.f. square wave signals are displayed.

The 0 position interrupts the signal and earths the amplifier input for quickly determining the 0 V level.

2.2.4. Triggering

If a signal must be displayed, the horizontal deflection must always be started on one fixed point of the signal in order to obtain a stationary display. The time-base generator is, therefore, started by narrow trigger pulses formed in the trigger unit and controlled by a signal originating from one of the vertical input signals, an internal voltage at mains frequency or an external source.

2.2.4.1. Trigger coupling

Three different trigger-coupling methods can be chosen with the DC/LF/HF switch. In the HF and LF positions, the transfer characteristic is limited.
In position DC the trigger signal is passed unchanged.
In position LF, a 0 Hz (10 Hz for external triggering) to 30 kHz band-pass filter is inserted. This position can be used to reduce interference from noise.
In position HF, a 30 kHz high-pass filter is inserted.
This position can be used to reduce interference from e.g. hum.

2.2.4.2. Selecting the trigger source and setting the trigger level

The trigger signal is obtained from channel A (button A depressed), channel B (button B depressed), the COMPosite A and B signals (buttons A and B simultaneously depressed), an external source (button EXT or EXT ÷ 10 depressed) or from an internal voltage at mains frequency (button EXT and EXT ÷ 10 depressed).
The trigger pulse shaper is a dual controlled multivibrator switched by the output signals of a differential amplifier.
The trigger signal is, together with biasing voltages which are adjustable with the LEVEL potentiometer, fed to the inputs of the differential amplifier.
Depending on the LEVEL setting, a certain part of the trigger signal will be amplified by the differential amplifier.
The multivibrator is thus switched at a fixed point of the trigger signal (see Fig. 2.4.). This means that, with the aid of the LEVEL control, it is possible to scan the shape of the trigger signal (in case of internal triggering A or B equal to the shape of the signal to be displayed) and, thus, to choose the point where the multivibrator will be switched.
The LEVEL potentiometer is fitted with a push-pull switch which allows selection of the trigger slope.

2.2.4.3. Automatic triggering

When the AUTOmatic button of the AUTO-TRIG-SINGLE switch is operated, and if there are no trigger pulses available, the time-base generator is automatically free-running.
The trace is, therefore, always visible. The AUTOmatic mode can be used in all cases where also the TRIG mode is usable, except with signal frequencies lower than 10 Hz or pulse trains with an off time exceeding 100 ms.
As soon as trigger pulses are available, the free-running state of the time-base generator is automatically terminated and the time-base generator is triggered again as described in sections 2.2.4.1. and 2.2.4.2.
When the TRIGgered or SINGLE button is operated, the auto-circuit is switched off. The LEVEL setting can also be used in the AUTOmatic mode.

2.2.4.4. SINGLE sweep triggering

When effects which occur only once have to be observed (usually photographed), it is often desirable to ensure that only one sawtooth is generated, even though several trigger pulses might be produced after the phenomenon of interest. Of course, the single sawtooth in question must be triggered by a trigger pulse. To this end, the SINGLE button must be pressed. The first trigger pulse that appears after the button has been

released will start the time-base generator.
The time-base generator is then blocked until the SINGLE button is pressed again. The NOT TRIG'D lamp will light up as soon as the SINGLE button is depressed and remains lighting until the trigger pulse arrives.

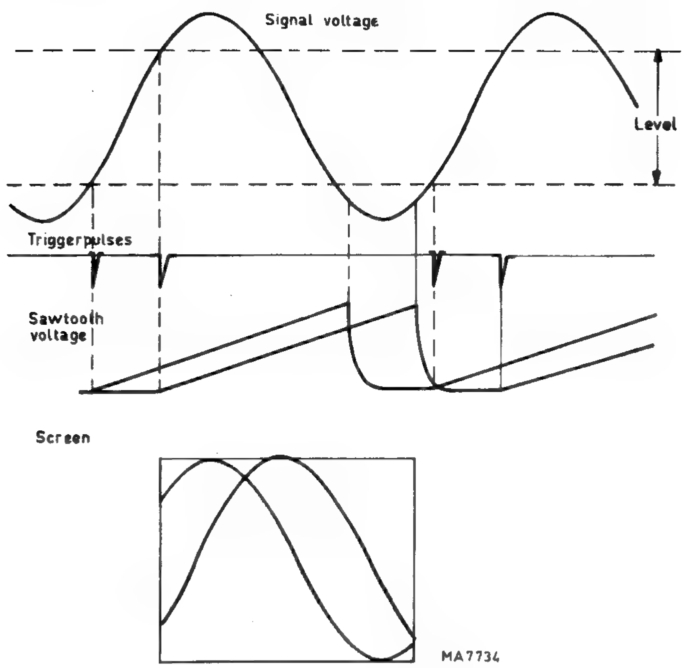


Fig. 2.4. Scanning the waveform by means of the LEVEL potentiometer

2.2.5. Time-base magnifier (R2/S3)

The time-base magnifier is operated by a push-pull switch incorporated in the horizontal-POSITION control If this switch is pulled to position x10, the sweep speed of the main time-base generator is increased by a factor of 10. Thus, the portion of the signal displayed over a width equal to one division in the centre of the screen in the x1 position (TB MAGNifier depressed), will occupy the full width of the screen in the x10 position.
Any portion of the trace can be brought on to the screen by the horizontal-POSITION control for scrutinisation. In the x10 position, the time coeffcient is determined by dividing the indicated TIME/DIV value by 10.

2.2.6. Use of the delayed time-base

The delayed time-base can be used for the accurate study of complex signals. When push-button MAIN TB of the delayed t.b. trigger-source controls (S21) is operated, immediately the delayed time-base is on (i.e. the TIME/DIV switch is not at OFF), a portion of the displayed signal is intensified in the MAIN TB position of the horizontal deflection controls (S2). The DELAY TIME control (R1) enables this intensified portion to be shifted along the time axis. The duration of the intensified portion, its length, can be controlled in steps and continuously by means of the TIME/DIV controls of the delayed time-base generator. When push-button DEL'D TB of the horizontal deflection controls (S2) is operated, the intensified portion occupies the full width of the screen. In the DEL'D TB position, the delay time, (i.e. the interval between the starting point of the main time-base and the starting point of the delayed time-base) is determined by the settings of the main TIME/DIV controls and the DELAY TIME control.

If one of the other del'd t.b. trigger-source controls (S21) is operated, the delayed time-base is started by the first trigger pulse that occurs after the selected delay time. This trigger pulse is supplied by the trigger unit of the delayed time-base generator. This position is used when time jitter would otherwise give a blurred image of the detail under observation. This time jitter could be part of the signal being investigated or, at extreme magnification, originate in the time-base circuits.

2.2.7. Use of the alternate time-base

The PM 3262 is equipped with display switching. This offers the instrument user a simultaneous display of the signal on the two time scales provided by the main time-base and by the delayed time-base.
Detailed examination of a certain portion of the main time-base display is enabled by expanding the time interval of interest by means of the delayed time-base. Expansion is achieved by selecting a correspondingly faster sweep for the delayed time-base TIME/div. control. Positioning of the time interval is set by the DELAY TIME potentiometer.

The part of the signal under detailed observation by the delayed time-base remains as an intensified portion of the main time-base display. This not only facilitates the location of the required detail during dialling but also serves as a visual indication of which portion of the overall trace is being examined. One can immediately correlate the detail with the overall signal, which may be extremely complex, without the necessity of switching between MAIN TB and DEL'D TB.

Vertical shift between the two time-base displays is continuously variable with the TRACE SEParation control (R6).

2.2.8. Use of the 3rd channel trigger view

2.2.8.1. External or Internal triggering

In many applications such as triggering with digital signals or signals of widely differing forms, it is necessary to use an external trigger source to ensure proper timing relationships and to know the time relationship of the trigger signal and the measuring signal(s). By depressing the TRIG VIEW push-button, the external trigger signal (fed to input socket X7) is displayed as a third channel with the threshold near the horizontal central graticule line. By adjusting the LEVEL/SLOPE (R7, S7) control, it is easy to determine which part of the trigger signal is initiating the sweep. This is also possible for signals internally derived from the A or B channel when push-button A or B of switch S22 is depressed.

The sensitivity control of the external trigger view mode has two steps, 100 mV/div and 1 V/div.
With the push-button switch EXT (S22) depressed the deflection factor is 100 mV/div which is compatible with ECL levels.
In the mode EXT ÷ 10 (S22) the deflection factor is 1 V/div which is compatible with TTL levels.

2.2.8.2. Single shot

With control LEVEL/SLOPE (R7, S7) the trigger level can be set at a predetermined value without the need of an input signal. This is of importance when the signal to be measured is not available in advance as when single events are under test. When input signals, which surpass a known threshold, have to be displayed, the trigger level (R7, S7) can be set in advance and an input signal of sufficient amplitude will initiate the time-base sweep.

The procedure to set the trigger level is as follows: Depress push-button TRIG VIEW.
Position the trace by means of the LEVEL (R7) control so many divisions in opposite direction (in relation to the horizontal central graticule line) as the trigger threshold is required.

Note: The trigger threshold is defined as the distance between the triggerpoint and the zero line of the amplifier (i.e. without input signals and deflection by means of POSITION controls).

3. Service manual

3.1. DESCRIPTION OF THE BLOCK DIAGRAM (FIG.3.1. PAGE 85)

3.1.1. General information

The PM 3262 oscilloscope comprises the following parts:

- a dual-channel vertical system
- a main time-base
- a delayed time-base
- a display-mode logic stage
- an X amplifier
- a Z-stage
- a c.r.t. circuit
- a stabilized power supply

3.1.2. Dual-channel vertical system

Both vertical channels contain identical circuits. An input signal to one of the channels is , via a coupling switch AC/0/DC, applied to the input attenuator. In the AC position of the coupling switch there is a capacitor in the signal path. In the DC position the coupling is direct.
If the coupling switch is set to the 0 position, the connection between the input socket and the attenuator input is interrupted, the latter being earthed.

The input attenuator, which is controlled by the AMPL switch, enables the adjustment of the vertical-deflection sensitivity in calibrated steps.

The attenuator is followed by a low-drift impedance converter which gives the input circuit a high input impedance.
The impedance converter also contains a voltage divider which works in conjunction with the input attenuator.

The signal that leaves the impedance converter is applied to a balanced amplifier (D201-Y_A, D301-Y_B) where it is transformed into a push-pull signal. The balance amplifier has two outputs. From one of these outputs the signal is applied to a trigger selector stage and from the other one to an amplifier stage (D202-Y_A, D302-Y_B). This stage comprises the switch NORMAL/INVERT by means of which the phase of the signal can be inverted and the controls for vertical trace positioning.

The following stage is a channel selector which either blocks or passes the signal as dictated by the vertical display-mode logic and switches.
In the A, B, ADD and TRIG VIEW modes the channel selector is set by means of voltage levels (via the display-mode logic stage) and in the ALT and CHOP mode controlled by pulses (also via the display-mode logic stage). In the ALT mode those pulses are supplied by the sweep-gating multivibrator of the main time-base generator during the flyback of the sweep, so that alternately the complete signals of channel A, channel B and the 3rd channel TRIG VIEW are displayed.
In the CHOP mode the drive pulses are provided by an oscillator which works at a fixed frequency of approximately 1 MHz.
Those pulses cause the electronic switches in the display-mode logic stage to be successively opened and closed so that successively part of the signal of channel A, channel B and the 3rd channel TRIG VIEW are displayed.

After the channel selector, the following circuits are common to the vertical channels.
A delay line that delayes the vertical signals to such an extent that the steep leading edges of fast signals are still displayed, a delay line driver stage and a final output stage which feeds the signals to the vertical-deflection plates.

3.1.3. Time bases

3.1.3.1. Main time-base

The M.T.B. trigger and X-Deflection amplifier receives its signal from one of the vertical channels or both (COMPOSITE), from the attenuator/impedance converter for external trigger or X deflection signals, or from the power supply (MAINS). One of those signals can be selected by operating one of the controls incorporate in this stage.

From this stage the signal is fed to either the X-Deflection amplifier for horizontal deflection, or the sweep-gating logic for starting the time-base generator. The MTB trigger and X-Deflection amplifier is a differential one, containing the controls for trigger-level adjustment, slope selection and coupling (i.e. DC/LF/HF) selection.

The slope selector allows the polarity of the trigger signal to be inverted, enabling triggering on the positive as well as on the negative slope of the input signals.

The sweep-gating logic starts and stops the time-base generator which delivers the sawtooth signal required for normal time-base operation. The generator comprises the charging capacitors and resistors selected by the TIME/DIV switch in order to set the time coefficients in calibrated steps. Continuous control of the time coefficients is obtained by varying the charging current of the time determining capacitors by means of the TIME/DIV continuous potentiometer.

The amplified output signal of the time-base generator is fed to the X deflection selector, the comparator which is part of the delayed time-base unit and via a feedback loop to the hold-off circuit. The hold-off circuit resets the sweep-gating flip-flop (D901) and blocks its input during the flyback of the sawtooth signal. The hold-off circuit also incorporates the single-sweep circuit.

The three modes of operation of the main time-base are determined by the three-position switch AUTO/TRIGG/SINGLE.
In the AUTO mode, the automatic free-run circuit is operative when triggering pulses are absent. Thus a trace, though not necessarily a stationary one, is always displayed even though the trigger controls may not be correctly adjusted. In this way, correct adjustment of the oscilloscope trace is greatly facilitated. However, when trigger pulses are present the circuit reverts to the normal triggered mode. If trigger pulses disappear, the time-base free-runs after a lapse of approx. 100 ms. In the TRIGG. mode, a display is present only when suitable trigger pulses are available.
In the SINGLE mode, events that occur only once can be observed and photographed if necessary. It is often desirable to ensure that only one sweep is generated, even though other trigger pulses might follow the phenomenon of interest. In this mode, after the trigger pulse has initiated the main time-base to produce one sweep, the circuit is unaffected by further trigger pulses until it is reset for the next event by operating the reset push-button.

3.1.3.2. Delayed time-base

The delayed trigger-circuit and delayed time-base generator comprise in principle the same circuitry as the main trigger-circuit and main time-base generator. The delayed time-base works always in the single-shot mode. It is started by the main time-base generator which also serves as hold-off circuit for the delayed time-base.

The DELAY TIME multiplier control, the comparator and the reset multivibrator determine the delay time for the delayed time-base generator.

When push-button MAIN TB of the horizontal deflection mode controls has been depressed, the part of the trace coinciding with the delayed sweep is intensified, except in the OFF position of the delayed TIME/DIV switch.

3.1.4. X-Deflection selector

The X-deflection selector couples the external X-deflection signal, the output signal of the main time-base generator, the output signal of the delayed time-base generator or the combined output signals of the main and delayed time-base generators via the X-final amplifier, to the horizontal-deflection plates. The X-final amplifier comprises the horizontal trace positioning and 10x magnification controls.

The "alt-" and "chop"- mode stages supply blanking pulses to the Z amplifier. "Alt" pulses blank the trace at the end of the sweep of the main time-base and provide an extra bright-up pulse if the oscilloscope operates with a portion of the trace intensified. "Chop" pulses suppress the trace during the switching from channel Y_A to channel Y_B and/or the 3rd channel TRIG VIEW.

3.1.5. Z Amplifier and c.r.t. circuit

The Z amplifier receives two input signals. One originates in the time-base generator and is, via the X-deflection selector and alt-mode circuit, applied to the Z amplifier to blank the trace during the flyback.
The other one is supplied by the chop-mode circuit to blank the trace during switching from channel to channel in the chopped mode. The INTENS potentiometer determines the amount of input current fed to the Z-amplifier.
At the output of the amplifier, the signal is split into two parts: an l.f. part and an h.f. part. The h.f. part is fed direct to the Wehnelt cylinder of the c.r.t. An oscillator signal is modulated by the l.f. part of the measuring signal and afterwards detected in a peak-detector. Both signal parts are combined again on the Wehnelt cylinder.

The focus voltage for the c.r.t. is derived from a grid driver stage. The output voltage of this stage is rectified and applied to the focussing anode. The focussing voltage is controlled by the FOCUS potentiometer which is electronically coupled with the INTENS potentiometer. In this way, defocussing due to operation of the INTENS potentiometer is largely obviated.

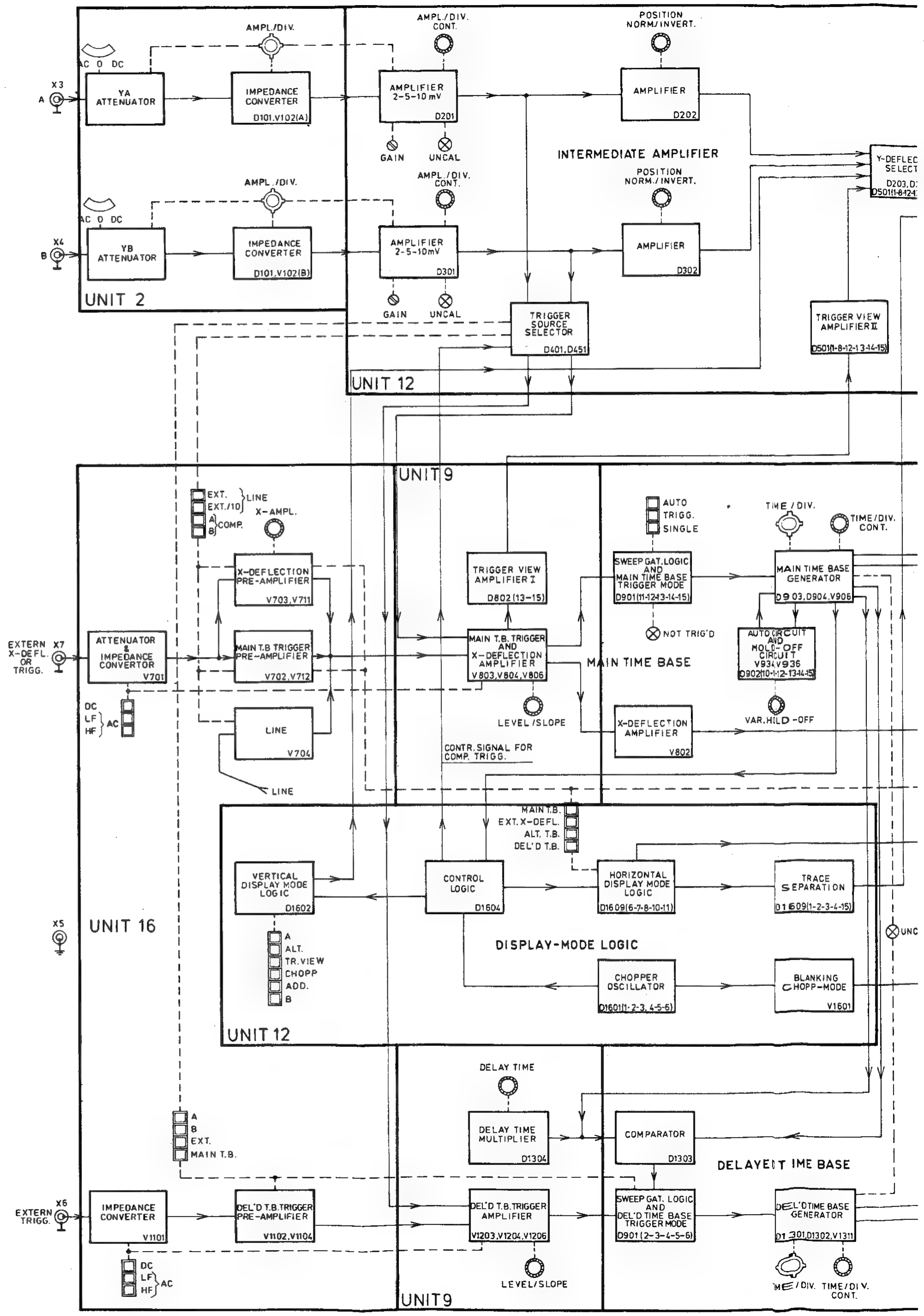
The high voltage for the post-acceleration anode of the c.r.t. is supplied by a secondary high tension winding of the converter transformer whose voltage is rectified and multiplied by a factor of 9.

Furthermore, the c.r.t. circuitry comprises preset potentiometers for trace rotation, astigmatism, geometry and orthogonality.

3.1.6. Stabilized power supply

The mains voltage is full-wave rectified and fed to a regulated sine converter.
The output voltage of the sine converter is kept constant by regulating the duty cycle of the applied voltage. This output voltage is applied to the primary of a transformer, the secundary voltages of this transformer are full-wave rectified, smoothed and applied to the various circuits.

The MAINS triggering signal is taken direct from the mains and, via an opto-isolator, fed to the trigger circuitry on a safe level.
The calibrator is a square-wave generator which supplies an accurate voltage and current for calibration purposes.



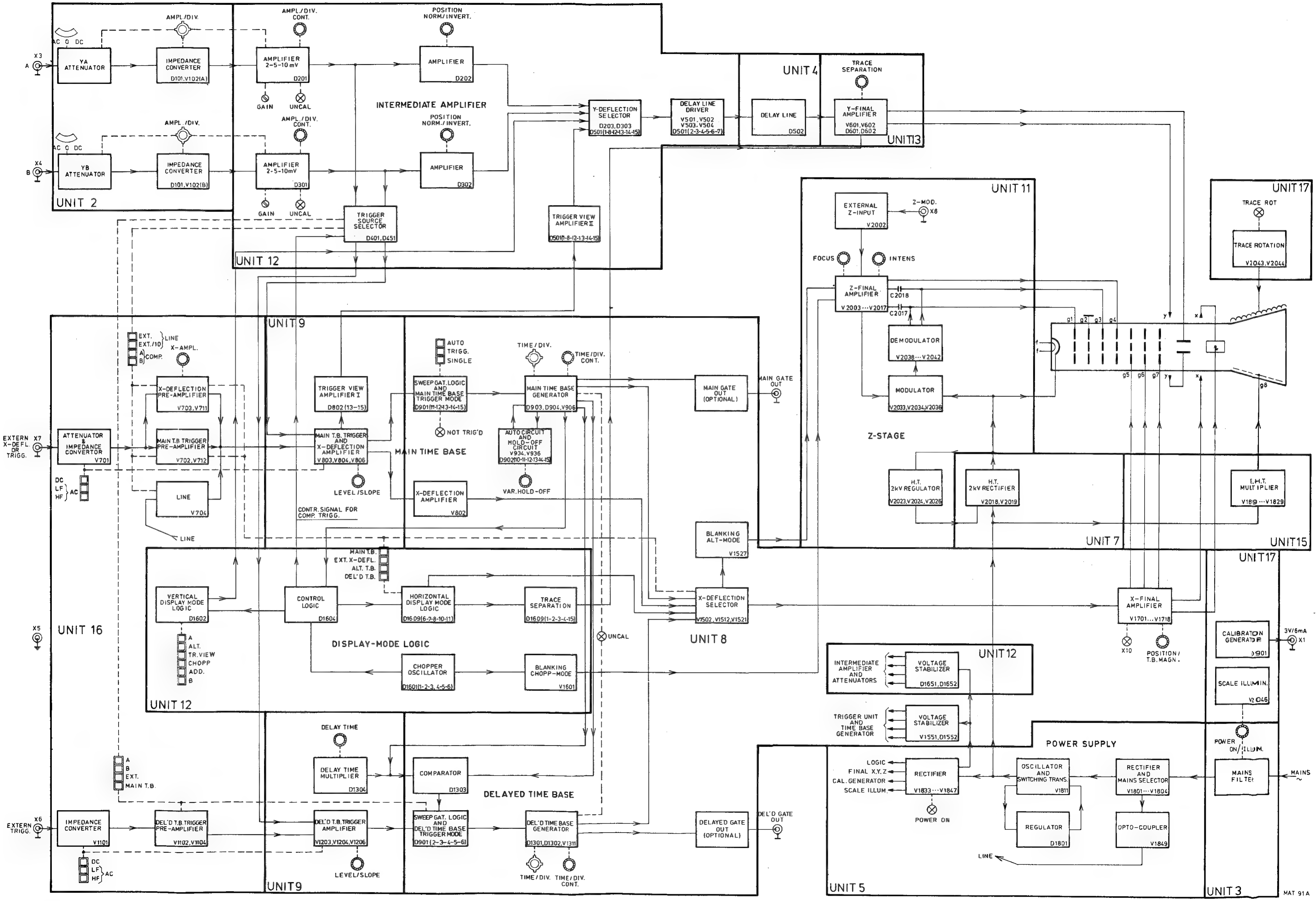


Fig. 3.1. Block diagram

3.2. CIRCUIT DESCRIPTION

3.2.1. Vertical deflection system

The oscilloscope contains three vertical channels, channels A and B and the TRIGger VIEW channel.
The vertical channels A and B for the signals to be displayed are identical, each comprising an input coupling switch, an input step attenuator, an impedance converter and a preamplifier with trigger pick-off.
A channel switch, controlled by the display mode pushbuttons, switches either channel A or channel B or the TRIGger VIEW channel to the final Y amplifier via the delay line driver and the delay line. The final Y amplifier feeds the Y deflection plates of the cathode-ray tube.
The individual stages of the vertical deflection system are now described in some detail.
As the channel paths for channel A and channel B are basically identical, only the channel A signal path is described.

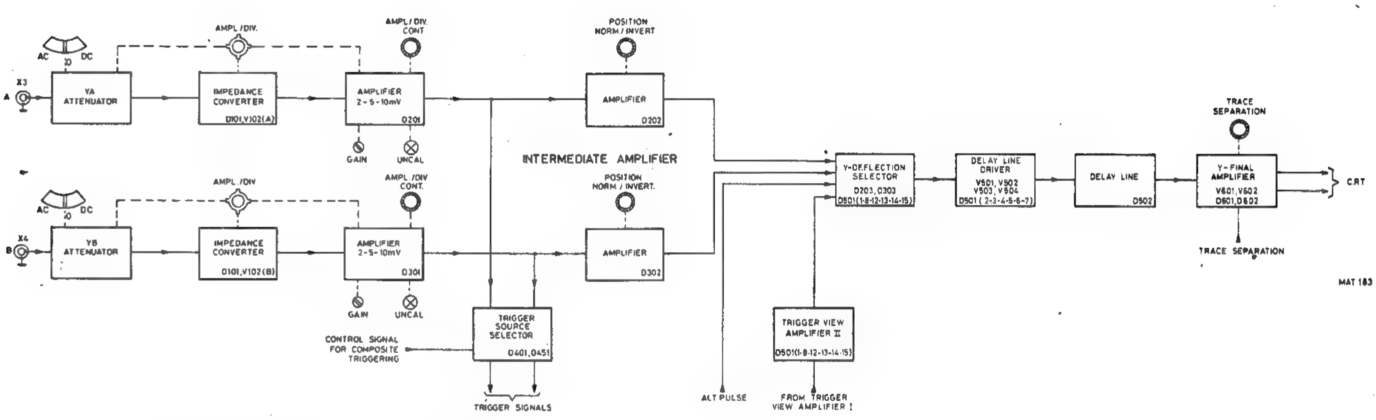


Fig. 3.2. Vertical deflection system

3.2.1.1. *Input coupling*

Input coupling switch S17 (AC-0-DC) forms a part of the input attenuator unit (Unit 2).
Input signals connected to the A input socket X3 can be a.c. coupled, d.c. coupled or internally disconnected.
In the AC position of S17, there is a capacitor (C102) in the signal path. This capacitor prevents the DC component of the input signal from being applied to the amplifier and reduces so the lower frequency limit to 10 Hz.
In position DC of switch S17, the input signal is coupled directly to the step attenuator and at the same time, blocking capacitor C102 is discharged via R101, to prevent damage of the circuit under test by a possible high charge.
Selection of the 0 position of S17 isolates the channel A input signal and earths the channel input for reference purposes; e.g. for calibration or centering the trace.

3.2.1.2. *Input attenuator and impedance converter*

The input stage comprises two identical attenuator circuits which are combined in one unit (unit 2).
For convenience, only the channel A attenuator is described.

The input attenuator consists of a triple high-ohmic voltage divider and an impedance converter in conjunction with a drift-correction circuit. The impedance converter provides an output at zero level, which can be adjusted by potentiometer R129, followed by a low-ohmic attenuator with attenuation factors of 1, 2 and 5.

The overall attenuation of the input stage is determined by the combination of the selected sections of two voltage dividers. The various combinations are selected by the eleven positions of the front panel AMPL/DIV attenuator switch S9.

The high-ohmic voltage divider sections attenuate by a factor of X1, X10 and X100. The low-ohmic divider D102 following the impedance converter, V102, V103, V104 gives attenuations of X1, X2 and X5 at the output. With the overall combinations of attenuation, eleven Y deflection coefficients are realised from 2 mV/DIV to 5 V/DIV in a 1-2-5 sequence. Only for the most sensitive positions 2 mV/DIV and 5 mV/DIV of the AMPL/DIV switch S9, the gain of the intermediate amplifier is increased.

Constant input capacitance for the various attenuator positions is achieved by trimmers C101, C104 and C109. The high-ohmic voltage divider sections are made independent of the input frequency (i.e., the capacitive attenuation for a.c. signals is adjusted to the resistive attenuation for d.c. signals) by means of trimmers C107 and C112.

A diode clipper V101, in the gate circuit of FET-transistor V102 protects the input source follower of the impedance converter from excessive voltage swings.

The high frequency path of the input signal consists of capacitor C114 and FET-transistor V102 connected in a source-follower configuration. The low frequency path of the input signal consists of error amplifier D101, which samples the input and output signals of the impedance converter over a frequency range from d.c. to 1 kHz. The error amplifier generates a correction signal on pin 6 which is fed to the impedance converter to replace the missing low frequency components of the high frequency path.
The gain of the low frequency path is set by adjusting the resistor divider ratio from which the output is sampled. Preset R 132 (L.F. corr) is adjusted so that the ratio of the network R134/R132 is the same as the ratio of network R122/R123. The off-set voltage of the error amplifier is corrected by preset R124.

After low-ohmic attenuator switching, the output from the impedance converter provides a correct impedance match for the coaxial cable to the intermediate amplifier.

3.2.1.3. *Intermediate amplifier*

The intermediate amplifier comprises two main stages.
The first stage comprises the gain adjustments, vernier and continuous control, level shifting, and sensitivity for the 2 mV, 5 mV and 10 mV ranges.

The second stage comprises a series-shunt feedback amplifier circuit formed by D202 input transistors and transistors V502, V504 on the delay-line driver circuit. Interposed in this stage are the normal/invert, shift and electronic switch facilities.

Both stages have overall gains of approximately 3.

To improve temperature control and stability, the intermediate amplifier mainly comprises integrated circuits. The signal paths for channel A and channel B are identical in the input stages, consequently, only the channel A input circuit is described.

The Y signal from the channel A attenuator is applied to a coaxial input socket on the intermediate amplifier, to pin 3 of integrated circuit D201. The asymmetrical input is converted to a symmetrical output in a transistor balance amplifier.

Potentiometer R211 provides a continuous balance control to correct for line shift.
Four diode-connected transistors across the base circuits of the D201 cascode transistors provide control of attenuation by means of GAIN control R12 and CONT. control R8, which vary the dynamic resistance of the diodes. Control R12 gives 5 % loss of gain in the mid-position and 10 % loss of gain at minimum. Control R8 gives a 3 to 1 attenuation, which is sufficient to give the desired overlap between the input attenuator steps. When the currents through the diode bridge are equal, there is no gain and the transistors are cut off. When current flows in one diode and not in the other, the gain is maximum.

The cascode transistors V204 and V203 that follow integrated circuit D201 provide additional gain for the most sensitive ranges by the selection of load resistors. By switching this additional gain at intermediate amplifier level a reduction in noise is achieved.
The different loads of V203, V204 are selected by switching diodes under the control of the front-panel AMPL switch positions.
In the 10 mV-5 V positions the - 5.2 V supply from AMPL/DIV switch S9 contact 14 is applied to the junction of R241, stabistor V208 and diode V211. The stabistor V208 conducts and applies the negative potential via switching diode V206 to load resistors R233 and R237 of V204 and V203 respectively. Diode V211 also conducts and blocks V213, thus causing transistor V214 to switch off and disconnect the load resistors R236 and R239.

In the 5mV position, the - 5.2 Vsupply from AMPL/DIV switch S9 contact 20 is applied to the junction of R242, and diodes V209, V212. Diode V212 conducts and applies the negative potential via switching diodes V207 to the load resistors R234 in series with R233 and R238 in series with R237 of V204 and V203 respectively. Diode V212 also conducts and blocks V213, thus causing transistor V214 to switch off and disconnect the remaining load resistors. To compensate for the reduction of bandwidth in the 5mV position because of the higher value of the load resistor, an additional capacitor, C202, is switched into the emitter circuit via R212 and diodes V201 and V202.

In the 2mV position, transistor V214 conducts because of the 0V applied to its base via R243 and V213. The resulting negative potential on its collector is applied to the total load resistors R237, R238, R239 and R234, R233, R236 of V204 and V203 respectively. In this position, switching diodes V206 and V207 are blocked. The 2 mV position is an extra facility, the bandwidth being degraded to 35 MHz.

To compensate for any shift of the trace that may occur when switching between the 5 mV and 10 mV positions, preset R216 is provided. It permits the emitter current of V203 to be adjusted, as required.

Emitter potentials for V203 and V204 are routed via feed resistors R218 and R219 respectively. The RC networks R219, C212 and R222, C214 provide damping. Series RC networks R214, C208 and R208, C206 on points 1 and 8 of the cascode circuit of D201 prevent any tendency for parasitic oscillation.
The second stage of the intermediate amplifier is a voltage-to-current amplifier that incorporates the trigger pick-off point, the NORMAL/INVERT switching facility, and the channel selection switching. The stage basically comprises two integrated circuits D202 and D203.
Emitter points 4 and 5 (D202) of the input transistors provide the trigger pick-off points that are routed to resistors R421 and R422 on the trigger circuit. A number of RC networks across the common emitter circuit provide for bandwidth compensation over the frequency range. Preset components are R253, R254 R255, R257 and R244.

The NORMAL/INVERT function is performed by a diode-gate switching circuit under the control of the PULL TO INVERT switch S4. In the NORMAL position, i.e. S4 is open, transistor V216 conducts because of the negative base potential applied via R271. Point 11 of D202 is therefore at 0V and this is applied to the bases of two transistors, which conduct and pass the signal through D202 without inversion (points 1-14, 8-12). The negative potential via R269 is passed to point 9 of D202 on the appropriate side of the diode gate network. This negative potential is applied to block the bases of the other pair of transistors in the signal path.

In the INVERT position, i.e. S4 is closed, V216 is cut off because of the 0V potential applied via R271. Point 11 of D202 now becomes negative via R268 and this switchess off the two transistors that were previously conducting. The signal path is now inverted through the integrated circuit (points 1-13, 8-15) by the 0V signal applied via S4, R267 to point 9 of D202.

Any trace shift due to inversion can be corrected by preset R259.
The output signals are fed to pins 1 and 8 of integrated circuit block D203, the emitters of the electronic switching transistors. Channel selection is by means of a network, controlled from the logic circuit.

Front-panel POSITION control R3 applies a variable potential to the base of one of the input transistors to provide a means of shifting the trace.

3.2.1.4. Trigger pick-off and trigger source selection

The symmetrical trigger inputs from the A channel intermediate amplifier (D202) are fed via resistors R421 and R422 to points 3 and 6 of D401.
The symmetrical trigger inputs from the B channel intermediate amplifier (D302) are fed via resistors R471 and R472 to points 3 and 6 of D451.
Diode switches are again employed for channel switching for triggering on channel A, channel B or for composite triggering.
The outputs are asymmetrical and are taken via coaxial sockets to the trigger amplifier of the Main and Delayed time-bases.
The operation of the two integrated circuits D401 and D451 is identical. Therefore, only the channel A circuit D401 is described.

Transistor V401 provides a constant current source for the trigger pick-off stage for channel A. The collector output (point 7) is resistor-coupled to the common emitters of the switching transistors to provide a high gain output on point 13 (MTB trigger output) and point 15 (DTB trigger output) when the appropriate triggering is selected. Switching is achieved by front-panel selection. When channel A (DTB) is selected, the +11,4 V from point 2 of S21-A (which blocks V403 in the channel A OFF position) is removed and V403 conducts the channel A trigger signal (D401/15) to the delayed time-base trigger amplifier. When channel A (MTB) is selected, the +11,4 V from point 1 of S22-A is removed and V404 conducts (V407 off) to pass the channel A trigger signal on D401, point 13) to the main time-base trigger amplifier.

In the composite triggering mode, which is only functional when also ALT mode is selected, point 4 of S22-A is open circuited, consequently, transistors V408 and V458 and also transistors V457 and V407 are now controlled by a signal coming from the vertical logic circuit via R1622 and R494 . This signal brings transistors V458 and V408 alternately into conduction to enable triggering on the channel being displayed.
Transistor V409 inverts the logic input signal to allow alternate switching of the two channels.
Diodes V454 and V404 are alternately conducting and the A and B trigger signals are alternately routed to the MTB trigger amplifier.
Presets R431 and R481 enable the switching points of the diodes V404 and V454 to be set.
Presets R478 and R428 compensate for any current differences between the A and B triggering signals to enable the same current to be delivered to the trigger amplifiers.

3.2.1.5. Vertical display mode logic

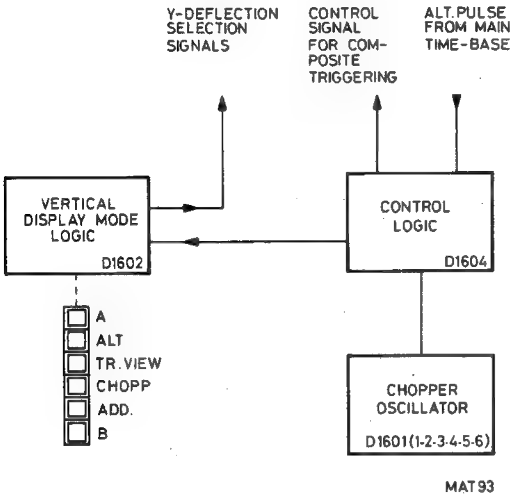


Fig. 3.3. Vertical display mode logic

This logic consists of digital circuits employing dual-in-line TTL integrated circuits. Vertical mode selection is made by selector switch S1.
The outputs that can be selected by the vertical display mode selector switch S1 are:
- channel A only
- channel B only
- TRIG VIEW signal only
- channels A and B added, chopped or alternated
- TRIG VIEW signal and channels A and B, chopped or alternated.

Positive logic is used in the digital circuits, the levels being as follows:
logic "1" = +5 V (high)
logic "0" = 0 V (low)

The different functions of the logic circuits are now described according to the vertical display mode selector switch S1.

A — selects channel A only. Via switch S1 the S input (point 7) of flip-flop D1604 is set to +5 V and the R input (point 8) to 0 V. The "high" level at output 10 is fed via two NOR circuits and R1628 to R283 in the A channel preamplifier to open the A channel signal path.
At the same time the control signals for the B and the TRIG VIEW channel are 0 V.

B — selects channel A only. Via switch S1 the S input (point 7) of flip-flop D1604 is set to 0 V and the R input (point 8) to +5 V. The high level at output 11 is fed via two NOR circuits and R1627 to R383 in the B channel B channel preamplifier to open the B channel signal path.
At the same time the control signals for the A and the TRIG VIEW channel are 0 V.

ADD – adds channels A and B. Inputs 2 and 5 of NOR circuits D1603 are connected to +5 V via switch S1, consequently both outputs 1 and 4 are low. They are fed via the NOR circuit and the resistors to R283 and R383 in the A and B channel preamplifiers to open both signal paths simultaneously. The TRIG VIEW control signal is 0 V then.

TRIG VIEW – selects the trigger signal only. Via switch S1 a +5 V is applied to points 4 and 5 of NAND D1607 (4-5-6). Output point 6 is fed via NOR D1602 (1-2-3) and resistors R1629 to R547 in the trigger view amplifier to open the trigger view signal path.
The channel A and B control signals are 0 V then.

CHOP – selects channels A and B chopped. In this position the chopper generator, which consists of NAND circuits D1601 (4-5-6) and D1601 (1-2-3), is switched into the circuit by a +5 V applied to input 4. The frequency of oscillation is 2 MHz. The output signal is fed via two NANDS to the clock input of flip-flop D1604. The only flip-flop of interest now is the first one. It divides the incoming frequency by two and switches at a frequence of 1MHz. The resulting high switching levels on the outputs 10 and 11 of the flip-flop provide the chopping signals for the A and B channels.
The control signal for the TRIG VIEW channel is blocked in this situation.

During switching over in the CHOP mode, the c.r.t. is blanked by pulses supplied via transistor V1601 to R2002 of the blanking stage.

ALT – selects channels A and B alternately for display. The circuit acts as in the CHOP mode, only the chopper generator is blocked and the circuit is driven now by the much slower switching signal applied to input 2 of NAND D1608 (1-2-3).
This switching signal is derived from the main time-base generator (V903) or the alternate time-base logic. These pulses switch the circuit at the end of each sweep and the channels A and B are alternately displayed.
In ALT TB mode the circuit is switched at the end of every two sweeps.
The control signal for the TRIG VIEW channel is 0 V.

ALT TRIG VIEW – selects channels A and B and TRIG VIEW alternately. So three signals can be made visible on the screen, but only one at a time is written.
For the generation of the control signals see Fig. 3.4. Clock pulses are here the alternate pulses.

TRIG VIEW CHOP – selects channels A and B and TRIG VIEW chopped. Three signals can be made visible on the screen, but now in chopped mode.
For the generation of the control signals see Fig. 3.4. Clock pulses are here the chopper generator output pulses.

Composite triggering

The output signal of point 10 of flip-flop D1604 is applied via R1622 to resistor R494 in the trigger source selector.

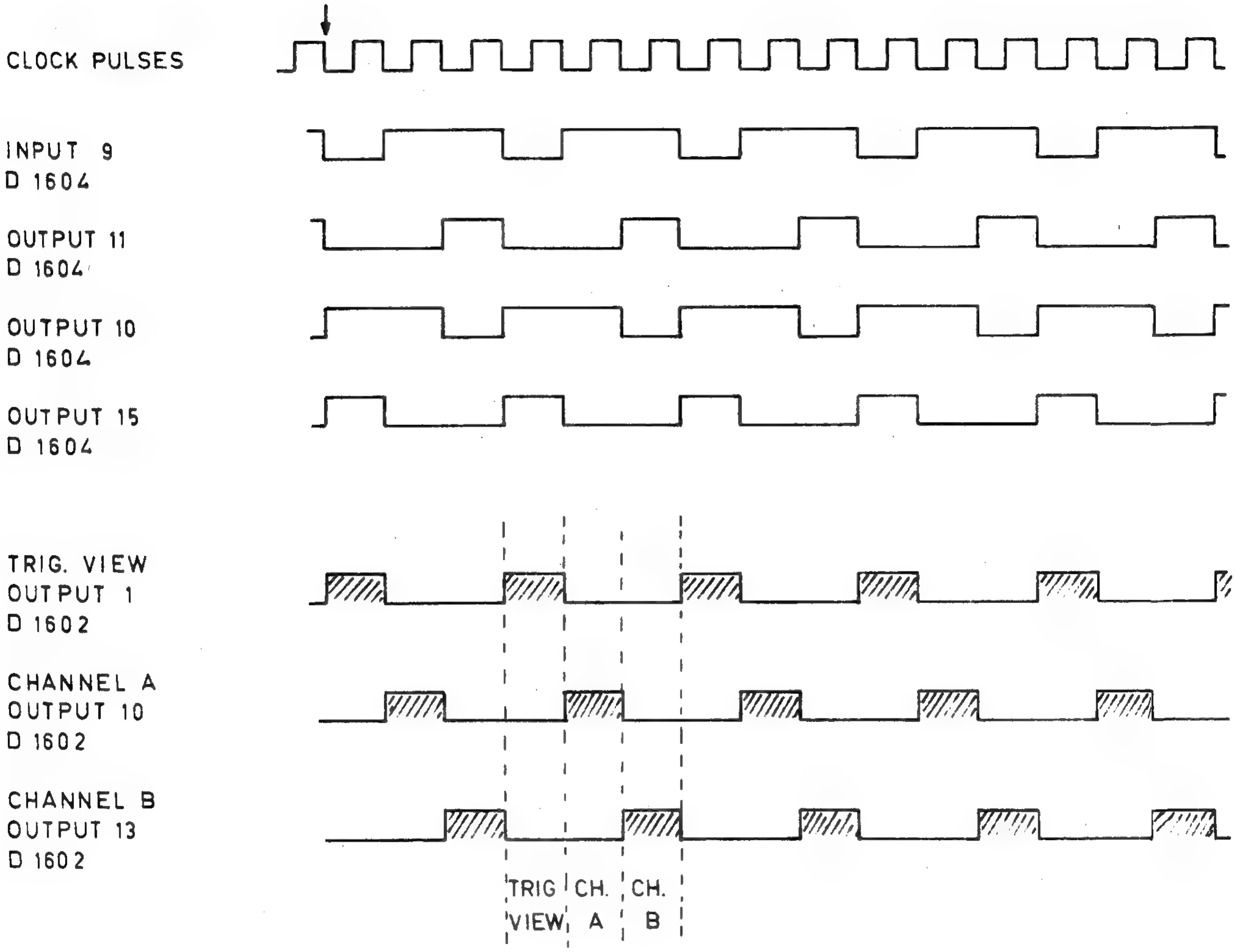


Fig. 3.4. Generation of control pulses.

MATB 3

3.2.1.6. Delay-line driver

The signal collector outputs from D203 (points 12 and 14) are coupled to the bases of the output transistors V502, V504 of the shunt-series feedback amplifier and each normally draws 10 mA from the current source of V501, V503.
When the channel is switched off by the resistor network, the signal transistors are blocked and the alternative transistors are switched on so that they now draw 20 mA current from the +11,4 V rail via resistors R502, R501, R508, R507.
Similarly, the collector outputs from D303 of the channel B intermediate amplifier are also coupled to the bases of V502, V504.
In the ADD position with both the A and B channels switched in, 20mA is fed to R282 and R379 and, similarly, 20mA to R279, R382. Since the alternative transistors in D203 and D303 are now switched off, only 10 mA is drawn via the R501 and R507.
The table shows the current distribution in the stage for the various operating modes.

MODE	CURRENT DISTRIBUTION		
A switched	10mA through R282	20mA through R538, R381	10mA through R279
B switched	10mA through R379	20mA through R538, R281	10mA through R382
ADD switched	20mA through R282 and, R379	20mA through R538	20mA through R279 and, R382
TRIG VIEW (see section 3.2.2.3.)	10mA through R541	20mA through R281, R381	10mA through R548

By the use of alternative transistors in the various switching modes, the current demands of delay-line driver stage are constant irrespective of the switching.

The collector outputs of transistors V502 and V504 are direct-coupled to the bases of the output transistors of the delay-line stage (points 3 and 6 respectively of integrated circuit D501). The collector outputs on points 2 and 7 of D501 feed the combined output resistor R552, the value of which, 120 ohms, matches the characteristic input impedance of the delay line.

A cable-type delay line is used with a characteristic output impedance of 75 ohms. From the delay line, the signals are routed to the vertical output amplifier stage, via input resistors R602 and R609, which terminate the delay line in 75 ohms. Transistors V601 and V602 in common-base configuration provide the first stage of the vertical output amplifier.

3.2.1.7. Final Y amplifier

The voltage signals present on R604 and R613 are applied to the bases of transistors (point 3 and point 6) of integrated circuit D601.
The emitters of these transistors (points 4 and 5) are fed from a constant-current source, V606, via transistors V607 and V603. The base of V607 is controlled via V608 from the TRACE SEP; potentiometer R6 on the time-base circuit.
This potentiometer varies the current on the side of the balanced amplifier to give trace separation in the ALTERNATE TB mode.
The networks R634, C613, R636, C614 and C616 provide delay-line correction at different frequencies.
High frequency compensation for this stage is achieved by V609, C617 and V611, C618 adjusted by preset R646. The NTC resistor temperature-controls the vari-cap capacitance and compensates for increase in temperature.
Integrated circuit D601 and thin-film circuit D602 form a shunt-series feedback circuit, followed by a cascode amplifier with voltage output developed across the load resistors inside D603.
The Y plates of the c.r.t. are fed via series chokes L601 and L602 damped by the parallel resistors R662 and R664.

Together with the capacitance of the c.r.t. plates, this forms a series resonant circuit to lift the gain at the high frequency end of the bandwidth. Preset R654 provides a measure of gain adjustment (20 % approx.) to allow for different c.r.t. sensitivities.
It controls the quiescent current of the diodes and thus the gain of the D601 amplifier stage.
Any unbalance in the c.r.t. deflection plates can be corrected for by the line centring preset R658, which provides a compensating current for one side of the balanced output stage.

3.2.2. Main time-base triggering

The trigger source switches for triggering the main time-base generator, can select any of the following input sources.:

- an internal signal from the vertical A channel
- an internal signal from the vertical B channel
- an internal composite signal of channel A and channel B
- a signal derived from the mains supply
- an external source.

All these sources can be used for both triggering and X Deflection purposes. Source selection is done by means of a trigger selector switch S22.

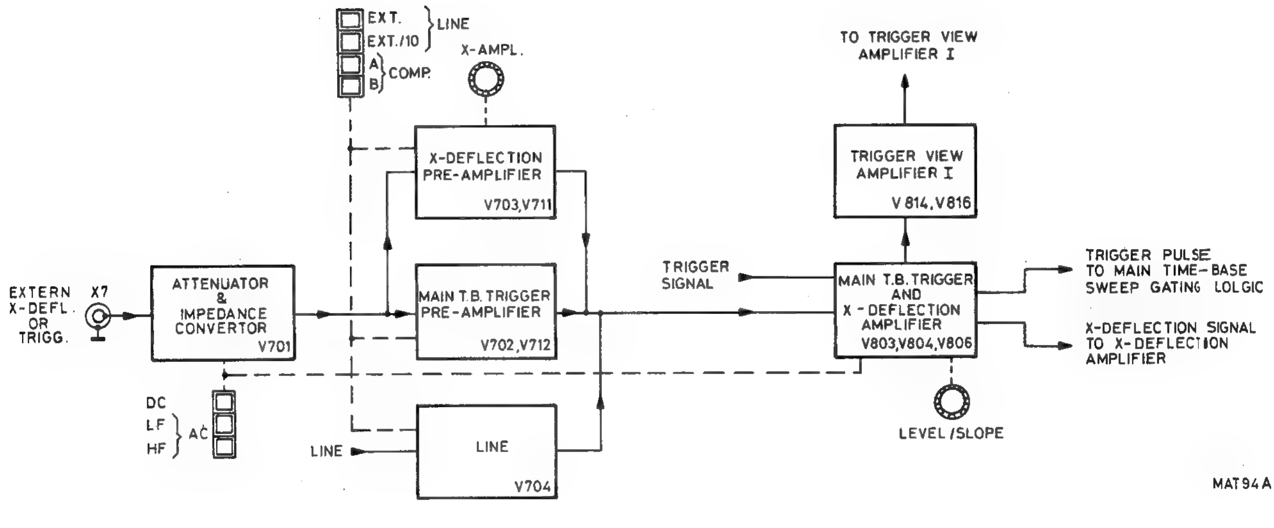


Fig. 3.5. Main time-base trigger circuit

3.2.2.1. Main time-base trigger source selector and preamplifier

The signal which is applied to the external trigger or X-deflection input X7 is attenuated via R702 and R703 by a factor of 10 in the EXT ÷ 10 mode.
When DC coupling is selected with switch S20, a DC path is formed via the resistors R707 and R708 to input 3 of D701. In the LF and HF mode the DC path is blocked. The l.f. component of the signal is fed via capacitor C704 to point 3 of D701 and the h.f. component is then fed via capacitor C703 to FET transistor V701. The output signal from V701 and D701 is then applied to the bases of the transistors V712 and V711.

In the modes A, B, COMP and LINE the junction of R714 and R718 is connected to ⊥ via switch S2, transistors V702 and V703 are conducting thus blocking the signal paths via the diodes V708 and V709.

In LINE mode R722 is not longer connected to ⊥ and transistor V704 is blocked. Diode V707 will conduct and the signal path for the LINE signal is opened.

When modes EXT or EXT ÷ 10 are selected there is no voltage applied via S22 to the junction of R714 and R718. In these modes there is only one of the transistors V702 and V703 conductive and the other one is then blocked.

If V702 is conductive, the signal path via diode V709 will be blocked. The signal path via diode V708 will be blocked when V703 is conductive.
If V702 or V703 conducts depends on the setting of switch S2.
There is no voltage applied via S2 to R716 and R717 in normal horizontal deflection by MTB and/or DTB signals. Transistor V702 is blocked, V706 and V703 conduct and the signal path via diode V709 is opened.
In EXT-X DEFL mode a +5 V signal is applied to R716 and R717 and V702 is conducting. At the same time V706 and V704 are blocked and the signal path via diode V708 is opened. The X-AMPL potentiometer R18 in the emitter circuit of V711 is now brought into the circuitry.

3.2.2.2. Main time-base trigger amplifier

The main time-base trigger amplifier consists of an input stage, coupling filters and a final amplifier. In this trigger amplifier, there is an output taken off for trigger view.

The signal current from the intermediate amplifier (channel A, channel B, or composite) is fed via the trigger source selector circuit to the emitter of V803. The output from the trigger source (EXT, EXT ÷ 10, or LINE i.e. mains frequency) is also fed to the emitter of V803.
This transistor, connected in common-base configuration, is coupled to the shunt feedback stage V804, V806. The output of this stage is diode-coupled to the filters for the various coupling modes.
By means of these filters, the input frequency range of the trigger circuit can be set.
The desired filter is switched in by biasing the appropriate switching diodes in the forward direction via two resistors. For example the DC position, selected by switch S20, is switched in by the −11,4V which causes diodes V809 and V812 to conduct. The LF and HF modes are selected in a similar way.

The filter section is coupled to an emitter-follower V813, which compensates for the temperature drift of transistor V804.

On the trigger amplifier, the trigger view signal and the trigger signal proper are split up by means of two amplifier stages.
The two transistors V816 and V817 accept the trigger signal. The transistors V814 and V818 accept the trigger level voltage. The LEVEL voltage control R7 permits variation of the trigger level of the signal.
The trigger view gain can be varied by means of preset potentiometer R842 in the emitter circuit of transistors V814 and V816.
The collectors of transistors V814 and V816 provide the trigger view output and the collector currents of transistors V817 and V818 are fed to the shunt feedback stage V821 and V822 respectively, thus providing the trigger signal.
In the negative position of the +/− SLOPE switch S7, the trigger signal is taken from one of the collectors via transistors V824 and V827 and in the positive position via transistor V823 and V826. +/− SLOPE switch S7 determines the polarity of the trigger signal. In the closed positon a 0V signal cause, V827 to conduct the negative trigger, and also switches off V829. In the open positon, V829 is switched on and the positive trigger is routed via V826 and V827 is blocked.
In this way, the appropriate trigger signal appear at the combined emitters of transistors V826 and V827.
This trigger signal is routed via a Schmitt-trigger formed by D802 (2-4-5), R894 and R895 to the flip-flop D901 in the main time-base sweep gating logic.

3.2.3. Main time-base generator

The main time-base generator comprises a sweep gating logic, a sweep generator, a hold-off circuit and an auto sweep circuit.

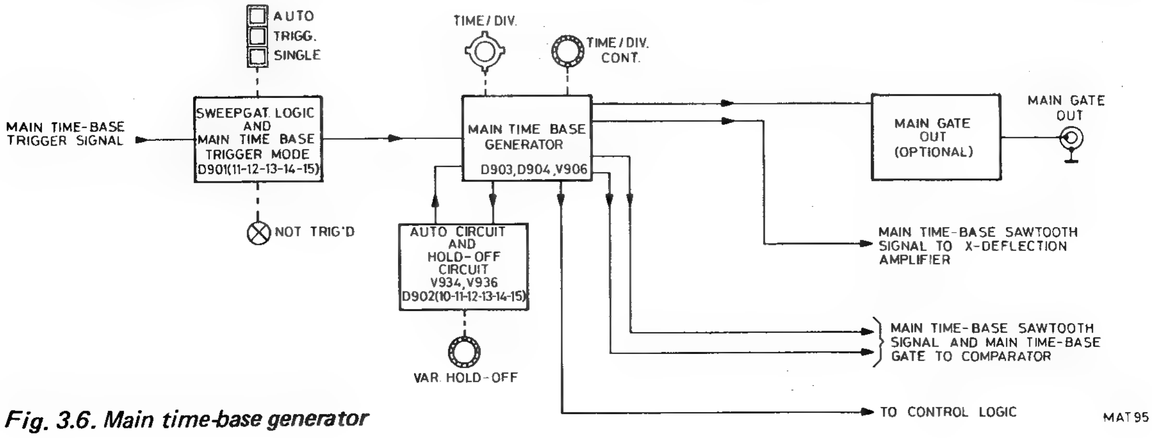


Fig. 3.6. Main time-base generator

The operation of the main time-base generator is based on the principle that a capacitor charges linearly when a constant-current source is applied, and can be periodically discharged rapidly by means of an electronic switch. In this way, a linear saw-tooth waveform is generated.

The constant-current source consists of transistors V913, V914 and integrated circuit D903. The emitter voltage of V914 has the same potential as point 3 of D903, therefore a constant voltage exists across the series circuit of R926 and the charging resistors on switch TIME/DIV S15. This voltage, and thus the charging current may be varied by means of potentiometer R11 and the preset potentiometers R911 and R913; which compensate for the tolerances of the timing capacitors.

In the TRIG. position V931 is switched off because of the +5,2 V applied to its base by switch S8 (AUTO). If point 14 of the master slave flip-flop D901 is logic "high" due to a trigger pulse, V929 will also be switched off.
Consequently, its collector will be negative and switching transistors V906, V907 will be turned off (discharge switch open) and the timing capacitors C916 and C917 in parallel (and C912, C913 or C914 as selected) will be charged. This charging voltage is applied via the buffer stage consisting of the Darlington pair emitter-follower V922, V923 (h.f. path) and via the operational amplifier D904 together with V924 (l.f. path) to point 12 of the R; S; flip-flop D902. This flip-flop reaches its switching voltage when the time-base-saw-tooth voltage rises to approximately +4,3 V. Output 14 will then be "high" and output 15 will be "low". Since the collector of V937 is positive (see operation of AUTO circuit), diodes V927 and V926 will conduct and the "high" output on point 14 of D902 will be applied to point 12 (S input) of flip-flop D901. This results in a "low" output on point 14 of D901 irrespective of the state of the other inputs. The "low" output causes V929 to start conducting and its collector becomes less negative. Consequently, switching transistors V906, V907 conduct (discharge switches closed), the timing capacitance is discharged and point 12 of D902 drops below the switching level. Transistor V944, the base of which was turned on by the "high" output (point 14) of D902, is now switched off.
In turn, transistor V956 (discharge switch for the hold-off circuit) is switched off and allows the hold-off capacitance (C928 and C926, C927 as selected) to be charged by current source V954, D906. The voltage on point 3 of D906 is derived from a resistor that carries the charging current of the time-base generator. Therefore, the charging current for the hold-off capacitance is proportional to that for the time-base capacitance, thus giving a constant relationship between time-base length and the hold-off time. Potentiometer R18 (HOLD-OFF) allows the length of the hold-off period to be increased by a factor of 10. When the voltage across the hold-off capacitance has risen to a value of approximately 4,3 V the flip-flop D902 will be switched to its original state (outputs 14 low, 15 high), via buffer stage V949, V948. The "low" state on the base of V944 causes it to conduct and turn on V956 to discharge the hold-off capacitance. As a result, point 10 of D902 drops below its switching level. The S input of D901 will also be low again, whereupon the clock input (point 11) will be effective. The D input (point 10) is coupled with the clock pulse. Due to this pulse the flip-flop is switched over, resulting in a low level on point 15 and a high level on point 14 to permit the new time-base sweep.

3.2.3.1. *Free run AUTO-circuit*

If as a result of a trigger pulse, the Q output (point 15 of D901) is low, V934 and V936 start conducting and provide a discharge path for capacitor C923. Resistor R957 has been selected so that the current through R958 is insufficient to bring the base-emitter voltage of V936 to 0,7 V; therefore, both transistors are cut off as soon as C923 has discharged, provided that the Q output has switched to "high" in the meantime. The voltage on the negative side of C923 is then approximately +3,5 V and V937 is turned off, as a result of which diodes V926 and V927 are able to transfer the pulse on D902 output 14 to input 12 of D901.
Transistor V931 is turned off because its base is held at +5,2 V via R959, R960 and R962 (switch S8 (AUTO) is interrupted in the AUTO position). Thus, with a trigger signal input the time-base operates in the same way as in the TRIG position.

However, in the absence of a trigger signal, when D901 output 15 is "high", capacitor C923 will be slowly charged to approximately –6 V. If before this charging time (0.1 s approx.), point 15 turns to "low" (due to a trigger signal), C923 is discharged again before V937 starts conducting. As a result, V937 remains switched off and the instrument is still triggered.

If the voltage across C923 is permitted to charge to –6 V (i.e. no trigger signals appear), V937 starts to conduct and the resulting negative on its collector blocks diodes V926 and V927. At the same time, the base voltage of V931 drops. Consequently, the pulse on output 14 of D902 is no longer transferred to input 12 of D901, but is fed direct to the switching transistors V906, V907 via diode V932 and transistors V931 and V929.

In this way, the time-base generator runs automatically without the intervention of a trigger pulse. Transistor V937 is conductive when the time-base generator is not triggered. The base of V939 is then low, as a result of which the transistor conducts and the NOT TRIG'D lamp (V2) lights.

3.2.3.2. *SINGLE SHOT mode*

In the trigger position SINGLE, the time-base hold-off capacitors are short-circuited by diode V953 and switch contacts S8 (AUTO) and S8 (TRIGG).
The flip-flop D902 must then be reset manually by the RESET button S8 (SINGLE), which applies +5,2 V via R975, V946 to input 10. After input 10 has been brought to a high level and the RESET button released, triggering can occur, but on one event only as the flip-flop is not reset automatically.
In the SINGLE mode, V937 is permanently turned off via R965 by S8 (AUTO) and S8 (SINGLE). Since diodes V941 and V942 are now conductive, the pulse on output 14 of D902 will be transferred to the base of V939.
Consequently, the NOT TRIG'D lamp will light during the period when output 14 of D902 is low, i.e. from the moment the RESET button is pressed until the end of the time-base sweep initiated by the incoming trigger pulse of the event under observation.

3.2.4. Delayed time-base triggering

The trigger source switches for triggering the delayed time-base generator, can select any of the following input sources.

- an internal signal from the vertical A channel
- an internal signal from the vertical B channel
- an internal signal derived from the main time-base to start the delayed time-base immediately after the selected delay time
- an external source

Source selection is done by means of a trigger selector switch S21.

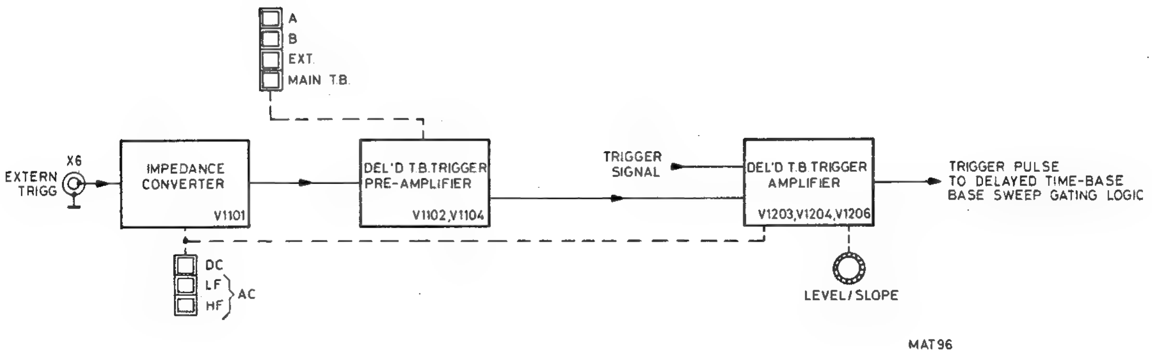


Fig. 3.7. Delayed time-base trigger circuit.

3.2.4.1. Delayed time-base trigger source selector and preamplifier

The signal which is applied to the external trigger input X6 is fed via the input stage consisting of FET transistor V1101 and integrated circuit D1101 to the base of V1104.
When DC coupling is selected with switch S19, a DC path is formed via the resistors R1103 and R1104 to input 3 of D1101. In the LF and HF mode the DC path is blocked. The l.f. component of the signal is fed via capacitor C1102 to point 3 of D1101 and the h.f. component is then fed via capacitor C1101 to FET transistor V1101. The output signal from V1101 and D1101 is then applied to the base of transistor V1104.

In the modes A, B and MTB the emitter of transistor V1102 is connected to the +11,4 V via switch S21, transistor V1102 is conducting thus blocking the signal path via the diode V1103.
When mode EXT is selected, there is no voltage applied via S21 to the emitter of transistor V1102. This transistor is blocked and the signal path via diode V1103 is opened.

The gain of the low frequency path is set by adjusting the resistor divider ratio from which the output is sampled. Adjusting is done with preset potentiometer R1118 (L.F. corr.).

3.2.4.2. Delayed time-base trigger amplifier

The delayed time-base trigger amplifier consists of an input stage, coupling filters and a final amplifier.

The signal current from the intermediate amplifier (channel A, channel B or composite) is fed via the trigger source selector circuit to the emitter of V1203. The output from the trigger source (EXT) is also fed to the emitter of V1203.
This transistor connected in common-base configuration, is coupled to the shunt feed-back stage V1204, V1206.
The output of this stage is diode-coupled to the filters for the various coupling modes.
By means of these filters, the input frequency range of the trigger circuit can be set.
The desired filter is switched in by biasing the appropriate switching diodes in the forward direction via two resistors. For example, the DC position, selected by switch S19, is switched in by the −11,4V which causes diodes V1208 and V1209 to conduct. The LF and HF modes are selected in a similar way.

The filter section is coupled to an emitter-follower V1212, which compensates for the temperature drift of transistor V1204.

The two transistors V1213 and V1214 accept the trigger signal and the trigger LEVEL voltage respectively.
The LEVEL voltage control R5 permits variation of the trigger level of the signal.
The collector currents of V1213 and V1214 are fed to the shunt feedback stage V1217 and V1218 respectively, thus providing the trigger signal.

In the negative position of the +/− SLOPE switch S6, the trigger signal is taken from one of the collectors via V1222 and diode V1223, and in the positive position via V1219 and diode V1221.

+/− SLOPE switch S6 determines the polarity of the trigger signal. In the closed position a 0V signal causes V1223 to conduct the negative trigger and also switches off V1227. In the open position, V1227 is switched on and the positive trigger is routed via V1221 and V1223 is blocked.
In this way the appropriate trigger signal is supplied to the time-base.

3.2.5. Delayed time-base generator

The delayed time-base generator comprises a sweep gating logic, a sweep generator, a comparator and an end of the sweep detector.

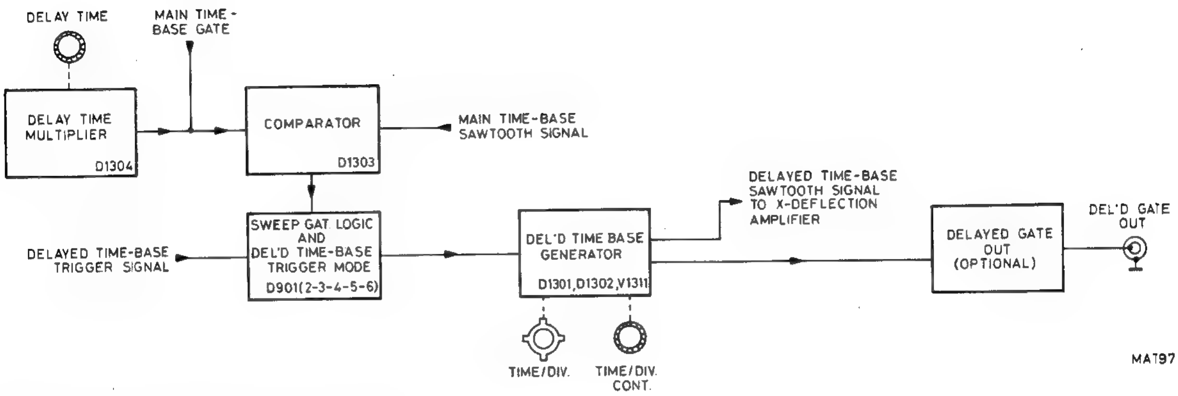


Fig. 3.8. Delayed time-base generator

Before considering these stages in detail, the general principle is briefly described.
Basically, the sweep gating logic, under the control of trigger signals from the trigger circuit and also feedback pulses from the end-of-the-sweep detector circuit, supplies square-wave pulses to the switching transistors V1309 and V1311 of the sawtooth generator. The time-base capacitors (effectively in parallel with the switching transistor) are charged linearly through a constant-current source to provide the forward sweep, and are discharged rapidly by the switching transistor to provide the flyback period. The resulting sawtooth is fed via the X-deflection selector to the X-final amplifier.

3.2.5.1. *Delayed time-base sweep generator*

The sweep speed or time coefficient is determined by the value of the time-base capacitance in circuit, and also by the magnitude of the charging resistor selected.
The time-base capacitors C1311, C1312 are always in circuit, the capacitors C1307, C1308 and C1309 are selected by the transistors V1319, V1322 and V1323 respectively. These transistors operate as electronic switches and are either fully cut-off or fully-conducting. They are switched on by the application of a positive voltage on their bases from the TIME/DIV switch S13. According to the position of S13 the transistors switches in one of the capacitors in parallel with C1311 and C1312.
As mentioned, the sweep speed is also dependent upon the magnitude of the accurate constant-current supplied by transistors V1317 and V1318. This current can be adjusted in steps by selecting the emitter resistance of V1318 by means of the TIME/DIV switch S13.

Continuous control of the charging current can be effected by varying the drive to point 3 of integrated circuit D 1301 with the continuous sweep control, TIME/DIV potentiometer R10.
Potentiometer R1326 enables the sweep speeds of the delayed time-base generator to be equalized to those of the main time-base generator.
Together with C1307 and C1309, transistors V1314 and V1312 are switched into the circuit by a +5,2 V voltage from the TIME/DIV switch S13. In these positions potentiometers R1323 and R1322 provides a fine adjustment for the timing circuit.
The discharge circuit for the time-base capacitors consists of transistor V1311, which is driven by the sweep gating logic.
The resulting sawtooth voltage is fed via an l.f. path and an h.f. path to the X-deflection selector. The l.f. path consists of integrated circuit D1302 and transistor V1328 and the h.f. path consists of transistors V1326 and V1327.

3.2.5.2. Delayed time-base end of the sweep detection circuit

This circuit prevents the sweep gating logic from responding to trigger pulses before the time-base capacitor has fully discharged. The sawtooth output is applied to point 7 of SR flip-flop D902.

At the end of the time-base sweep, output 2 of the SR flip-flop D902 will be "high" and output 3 will be "low". These logic levels are transferred to pins 5 and 4 respectively of D901 irrespective of the state of the comparator D1303. As a result, the $\overline{Q}$ output becomes "low" and the timing capacitors are discharged via V1311, since the flip-flop D902 is not reset until the end of the main time-base sweep (D902-15 on MTB connected via a differential network to D902-5 on DTB). This situation will persist until the next sweep of the main time-base. If the main time-base sweep is completed before the end of the delayed time-base, the R and S inputs (5 and 4) of D901 are switched over and the delayed time-base capacitors also are discharged.
The system can now be triggered again.

3.2.5.3. Delay time function

The function of the DELAY TIME potentiometer R1 is to provide an adjustable d.c. voltage for comparison with the sweep voltage of the main time-base generator. This comparison is then used to start the delayed time-base generator at a pre-determined time during the sweep of the main time-base.
The DELAY-TIME potentiometer R1 is a 10-turn front-panel control.

3.2.5.4. Comparator circuit and sweep gating logic

The comparator consist of an integrated circuit D1303. Transistor (points 6-7-8) is a constant-current source for the transistors (points 1-2-3 and points 3-4-5) of a differential amplifier.
The d.c. voltage set by the DELAY TIME potentiometer R4 is fed to the base of transistor (points 3-4-5). The sawtooth voltage of the main time-base generator is fed to the base of the other transistor. As soon as the amplitude of the sawtooth exceeds the set d.c. voltage, a high level is passed from D1303, pin 5, to input 4 of master-slave flip-flop D901 (R input), and a low level from D1303, pin 1 to S input 5 of D901.
The $\overline{Q}$ output on point 3 will then be high, with as result that V1304 and the time-base capacitor discharge switches V1309 and V1311 will be turned off. This is the situation in the MTB position of the switch S21.
In positions A, B or EXT of delayed time-base trigger selection switch S21, point 4 of D901 is always low via S21 The delayed time-base then starts first upon receipt of trigger pulses on clock input 6, after the S input has dropped to the low level.

3.2.6. X deflection selector and alternate time-base logic

Depending on the selected position of X deflection source selector switch S2, the circuit provides for X deflection by the main time-base signal, the delayed time-base signal, a signal from an external source or X deflection by one of the internal signals derived from channel A, channel B or the mains voltage. There is also the possibility to select, the main and delayed time-base alternately.

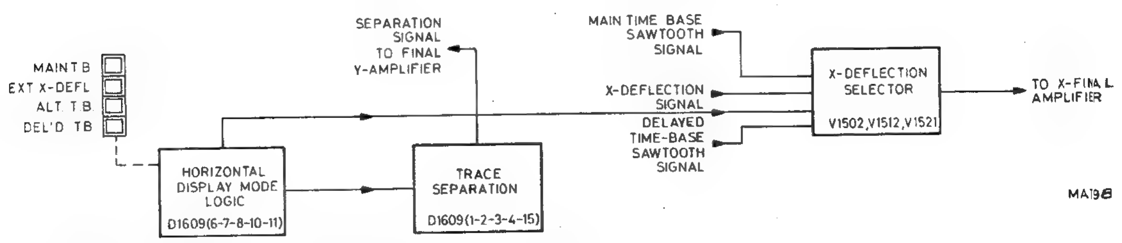


Fig. 3.9. X deflection selector and alternate time-base logic

The different functions of the logic circuits are now described according to the horizontal display mode selector switch S2:

MTB

– When no pushbutton is depressed or when MTB is depressed flip-flop D1609 is set in the MTB position via its R and S inputs (output 10 is high).
The MTB pushbutton releases all the other push-buttons of the horizontal deflection mode selector, its contacts are not used.
In the MTB position of switch S2, transistor V1509, which is driven by output 10 of flip-flop D1609, and consequently transistor V1511, conduct. Diode gate V1513, V1514 is therefore opened and the main time-base output is applied via transistor V1512 to the X amplifier, via these diodes and R1703.
In this mode only the main time-base sawtooth signal is fed to the X final amplifier and not the delayed time-base sawtooth signal and the X-deflection signal.

DTB

– With DTB selected flip-flop D1609 is set to the DTB state via its S and R inputs (output 11 is high).
In the DTB position of switch S2, transistor V1501, driven by output 11 of flip-flop D1609 and consequently transistor V1506 are conducting. The diodes V1503 and V1504 conduct and provide a signal path for the output sawtooth signal of the delayed time-base generator to the X final amplifier. With DTB selected the main time-base signal and the X deflection signal are blocked.

EXT X DEFL

– In the EXT X DEFL position a +5,2 V is applied via switch S2 to the base of V1516, with a result that the base of V1517 exceeds +5,2 V and this transistor is turned on.
Transistor V1524 then starts to conduct via R1528 and diode V1523 (8,2 V), and the external signal for amplifier V1519, V1521 is routed via the diode gate V1522, V1526 to the X amplifier.

When EXT X DEFL is switched off, transistor V1516 is turned off and transistor V1517 conducts via R1522. The collector of V1517 is therefore at +5,2 V, and as the voltage across diode V1523 is less than 8,2 V, this diode is blocked and transistor V1524 is turned off. In this position the X MAGN reed relay K1701 for the X1, X10, may be switched in. This is not operative when EXT X DEFL is switched on.

ALT TB

– With ALT TB depressed, the oscilloscope is set in the alternate time-base mode and the main and delayed time-bases are selected alternately.
ALT TB is not possible with DTB TIME/DIV switch S13 in the "OFF" position and with push-button TRIG VIEW of switch S1 depressed.
Switching over from MTB to DTB in ALT TB mode is achieved by switching in transistor V1509 and V1501 in turn via flip-flop D1609.
In ALT TB a +5 V signal is fed to input 4 of NAND D1606. With the delayed time-base switched off and with TRIG VIEW not depressed a 0 V signal appears at output 6 of NAND D1606. With this 0 V signal NAND D1608 (11-12-13) is blocked and flip-flop D1609 is set for normal switching by its clockpulse input signal. There is no longer a signal path for the alternate signal from the time-base generator to the vertical display logic other than via flip-flop D1609, NAND 1608 (8-9-10) and NAND D1607 (8-9-10).
The flip-flop output signal is also applied to R632 in the trace separation circuit to control the vertical space between the two time-base displays.

3.2.7. X Final amplifier

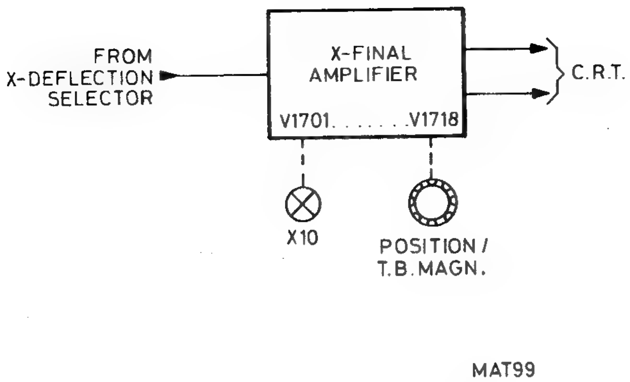


Fig. 3.10. X Final amplifier

The final X amplifier consists of two identical amplifier stages in parallel (one for each deflection plate). One stage consists of transistors V1706, V1707, V1708 and V1709 and the other consists of transistors V1714, V1716, V1717 and V1718.

The final stage is supplied from the +60 V and −60 V because the X plates of the C.R.T. are mechanically displaced such that they are less sensitive than the Y plates.

The amplifier stages are controlled via the transistors V1701 and V1702.

With the X POSITION potentiometer R2 the bias of transistor V1702 can be varied.
Potentiometer R2 consists of a tandem potentiometer with back-lash, giving a nice vernier control. Variation of the bias causes the balance of the amplifier to be disturbed, which results in a horizontal trace shift on the screen.

The X amplifier allows choice from X deflection by the time-base signals or one of the sources, channel A, channel B, line or an external signal. The X deflection source is selected with the aid of X deflection mode selector switch S2 and the X deflection source selector switch S22.
The selected X deflection signal is applied via R1703 to the base of transistor V1701.

The X amplifier offers the possibility of using either the nominal gain (X1 position of X MAGN switch S3), or the gain increased by a factor of 10 (X10 position of the X MAGN switch S3).
When the front-panel X MAGN switch S3 is operated for X10 magnification, the emitter resistance of V1701 and V1702 is shunted by resistors R1704, R1706 and R1707 via relay K1701, reducing the value by a factor of 10. Consequently, the gain of the stage is increased by the same factor.

The X1 gain can be set by potentiometer R1709 and the gain X10 by potentiometer R1706. The gain X10 is not operative when EXT X DEFL is selected.

Both outputs of the X final amplifier are connected to the X deflection plates of the C.R.T.

For correct orthogonality adjustment a signal from the orthogonality potentiometer R1737 is applied to R661 in the final Y amplifier.

3.2.8. Cathode-ray tube circuit

The cathode-ray tube circuit comprises the C.R.T. itself and the brightness, focus, astigmatism, geometry and trace rotation controls and the beam blanking amplifier.
A block diagram of the C.R.T. circuit is given in fig. 3.11

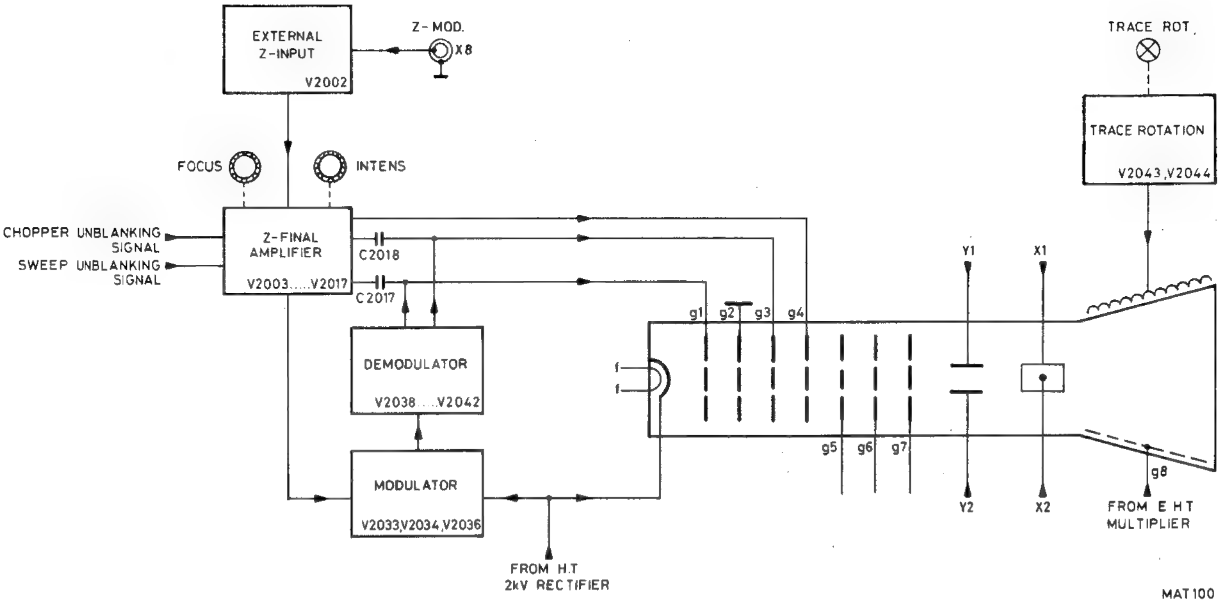


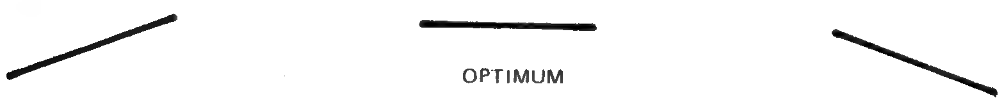
Fig. 3.11. Cathode-ray tube circuitry

3.2.8.1. C.R.T. controls

By means of the INTENS potentiometer R16, the brightness of the display can be continuously controlled. The display can be focused by means of the FOCUS potentiometer R17. Both INTENS and FOCUS controls are front panel controls.
Furthermore the C.R.T. circuitry comprises preset potentiometers for trace rotation, astigmatism and geometry.

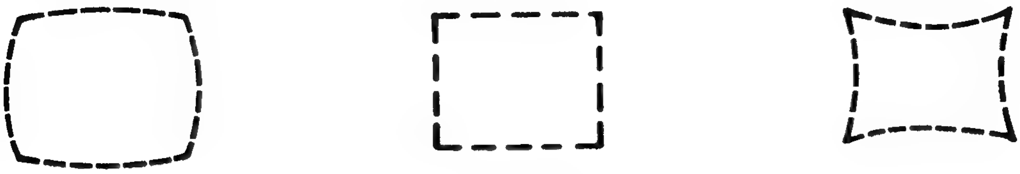
The FOCUS control R17 forms a part of a voltage divider network across the 2 kV output of the power supply.

TRACE ROTATION is achieved by means of the trace rotation coil. This coil mounted inside the mu-metal screen, provides a magnetic field for rotational control of the entire scan. The degree and direction of rotation is determined by the setting of front panel potentiometer R15 (screwdriver operated). The slider of R15 is connected to the bases of the complementary transistors V2043 and V2044. The trace rotation coil is supplied by these transistors.



With the ASTIGMATISM control R2037, the form of the spot can be adjusted by influencing the voltage on grid G4.

With the GEOMETRY control R2039 the barrel and pin-cushion distortion is corrected by influencing the voltage on the grid G6.



OPTIMUM

3.2.8.2. *Z unit and Focus unit*

In these units, the controls for the following c.r.t. grids are located:

G1	Wehnelt cylinder controlled between –2200 V and –2300 V
G2	Screen grid at earth potential
G3	Focusing grid, at approximately –1000 V ... –1100 V
G4	Astigmatism grid at ± 30 V (adjustable from –60 V to +60 V).

Focus and modulation

To maintain a well-focused spot, independent of the beam current, the voltage pulse is applied to the focusing grid G3. This pulse is in antiphase with, and has an amplitude of approximately 60 % of the Z pulse on G1. The phase shift is achieved by differential stage V2006, V2011. This stage is followed by individual driver stages for G1 and G3.
The a.c. pulse is applied to grids G1 and G3 via capacitors C2017 and C2018 respectively.

The d.c. transfer is obtained by means of an oscillator, driven via R2064 and R2067, and a demodulator working at e.h.t. level. The oscillator pulses are transferred via C2038 and C2039 to be demodulated by diodes V2038 and V2039 (positive components) and by diodes V2041 and V2042 (negative components). The a.c. and d.c. paths of G3 are equalised by the voltage divider R2083, R2084.

Z-unit

The Z-amplifier has the following inputs:
- via the INTENS potentiometer R16.
- the external input socket X8 (Z-mod.).
- two signals originating in the main and delayed time-bases are applied to the amplifier to unblank the trace during the sweeps.
- the chopper blanking pulse to blank the trace during switching from channel to channel in the chopped mode.

The bright-up pulse of the main and delayed time-base is obtained in a similar way. In the main time-base, the pulse that switches V907 is also used for switching on and off transistor V903 and diode V904. Diode V904 is conductive when the time-base is running and in that case consumes about 3 mA from the switching unit. When V904 is blocked (during the hold-off time) a current (Z pulse) flows via V902 to R1542 in the Z-unit. This current is consumed by V904 when this diode is conductive.

The same conditions apply to the delayed time-base. When the position DEL'D TB is selected, transistor V1527 on the switching unit is turned off and resistor R1539 feeds 3 mA into the Z amplifier unit, which during the delayed time-base sweep is consumed via R1534 by V1307.
The sequence is as follows:
- start MTB, start DTB; less than 3 mA = half intensity.
- then start DTB; end of DTB; 0 mA = brilliance (bright-up pulse)
- then end DTB, end MTB; less than 3 mA = half intensity
- end MTB, start MTB; more than 3 mA = blanked pulse.

During the hold-off period, 3 mA is applied via V1528. The trace is then blanked regardless of any other control signals. This applies to the chopper blanking circuit, which supplies current pulses of 3 mA, via R1609. Resistor R2001 also supplies 3 mA, which can be bypassed by transistor V2003 as determined by the position of the INTENS potentiometer R16. This provides a continuous control of the trace brilliance. Finally, the external input pulse may take over the current of transistor V2003 via V2002, independent of the set brilliance. As a result of the current flowing through R2001, the c.r.t. is blanked. The sensitivity of the external Z input is adapted to suit TTL logic. Logic "1" provides blanking; logic "0" is ineffective.

3.2.8.3. *CRT cathode regulation*

To prevent sensitivity variations of the c.r.t., the cathode voltage is regulated. Variations of the a.c. supply voltage are applied via C2028 to an amplifier consisting of V2026, V2024 and V2023; d.c. variations are applied via R2051. The collector voltage of V2023 compensates for the voltage variations of the power supply and the rectifier. Consequently, the cathode voltage remains independent of the cathode current.

3.2.9. Power supply

The power supply comprises a rectifier, a DC to AC converter regulator and a transformer and output voltage rectifier.

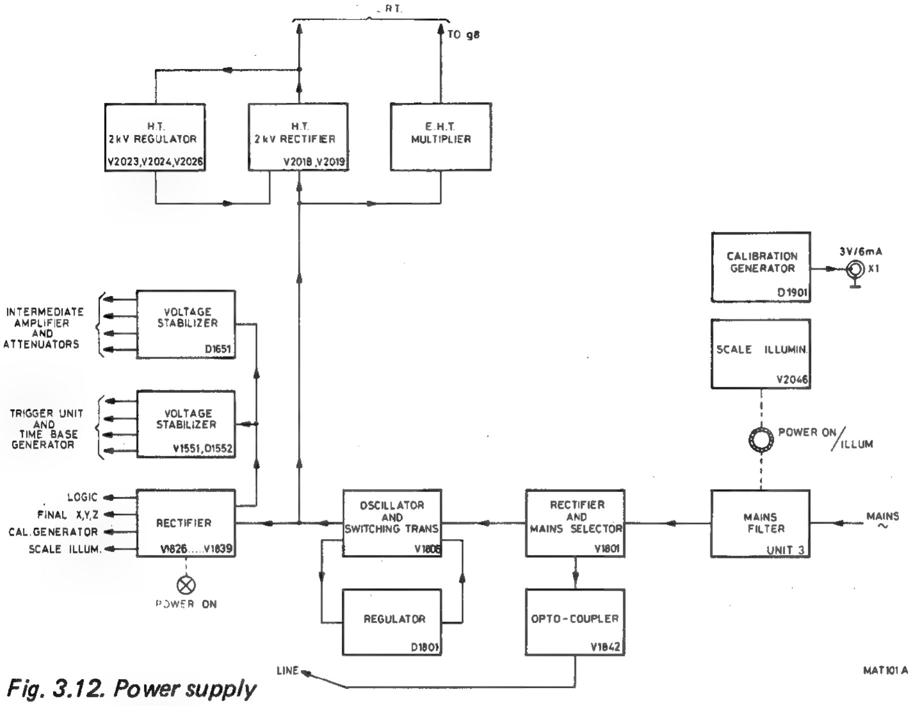


Fig. 3.12. Power supply

INPUT CIRCUIT

The power supply input circuit is matched to the 115V or 230V range with selector-switch S1801 which is located at the power supply unit at the rear side.
The mains voltage is rectified with the diode bridge V1801 and C1802, C1803, which form a voltage doubler in the 115V position of S1801, and a standard bridge rectifier circuit in the 230V position of S1801.
The voltage across the series circuit of C1802 and C1803 amounts 250V to 400V for both mains voltage ranges.

SWITCHING CIRCUIT

The unregulated d.c. voltage is applied in the form of pulses to a resonance circuit consisting of the primary coil of the convertor transformer T1801, combined with C1807 and C1808, via switching transistor V1806.
The sine-wave voltage (approx. 800Vp-p) across the primary coil of T1801 is kept constant by regulating the duty cycle of the base current of V1806.
The primary coil of L1806 which is in series with the switching transistor, limits the current through this transistor.
The energy stored in L1806 is fed-back to the mains rectifier circuit, during the cut-off time of V1806, via diode V1811.
V1808 and V1809 keep the dissipation during the switching moments out of transistor V1806; instead of this, these losses are dissipated in R1814 and R1816.
V1807 improves the base drive for V1806.

REGULATOR CIRCUIT

The regulator circuit itself consists of integrated circuit D1801 (type TDA 1060), the output (p.15) of which supplies a square wave current with variable duty-cycle to the base of V1812. The duty-cycle of this signal is variable.
The collector signal of V1812 is applied to the switching transistor via transformer L1803.

The regulator circuit is controlled by:

– Feed back voltage (p.3)
  This is the regulator control voltage and is taken from the rectifier circuit at the feed-back winding of T1801.
  This control voltage depends on the setting of R1826 (V out).

- Feed forward (p. 16)
  This voltage is derived from the mains voltage and provides direct mains variation compensation.
- Over-voltage protection (p. 13)
  This voltage is also derived from the mains voltage and inhibits the regulator output at too high mains voltages (the trip-level on p. 13 is 600mV).
- Current limit (p. 11)
  The voltage drop across the current-sense resistor R1811 controls the regulator circuit in case of overload.
- Frequency (p. 7)
  The resistance between p.7 and gnd estimates the convertor frequency.
  R1827 (Freq.) has been adjusted to obtain a frequency of 20kHz.
  The resonance frequency of C1807, 1808 and the primary coil of T1801 is wide enough to tolerate this.

Under normal working conditions the power supply voltages for the regulator circuit are delivered by the rectifier connected to the feed-back winding of T1801.
V1804 is then conducting so that V1803 does not deliver current.

SWITCHING-ON

Whenswitchingon the instrument, no supply voltages are available in the regulator circuit, from T1801.
At this moment V1804 is not conducting, so that V1803 is fully conducting, and the regulator circuit gets current via R1804 and R1806.
As soon as the converter circuit is working V1804 becomes conducting and V1803 is not conducting anymore.

SWITCHING-ON PROTECTION

If the instrument is switched-on and no convertor voltage would appear (due to a possible defect) the PTC resistor R1806 will warm up, reducing the current through V1803 to a safe low value.

OUTPUT CIRCUITS

The output rectifiers are of the coil-input types delivering the mean value of the sine-wave transformer voltage across the output capacitor. Except the d.c. voltage the convertor transformer delivers also:

- 6,3V for the c.r.t. heater
- 0–1kV –1,5kV for the focus and high tension circuits
- 120V for the additional power supply unit (not used in the PM3262).

PHOTOCOUPLER CIRCUIT

This circuit delivers a sine-wave voltage (derived from the mains voltage) used for mains triggering or mains deflection.
The photo-coupler V1842 which provides isolation between the mains voltage and the oscilloscope's circuitry drives the V1843-circuit in saturation, so that the square-wave voltage at the collector of V1843 has the same value for all mains voltages.
With an integration network R1851, 1852, 1853 and C1836, 1837, 1838 the original sine-wave is obtained.
Via V1844 and V1846 this signal is applied to the trigger selector (R730) via capacitor C1839.

3.2.10. Illumination circuit

The graticule of the C.R.T. can be illuminated by means of the bulbs E1 and E2. The intensity can be varied with the aid of ILLUM potentiometer R14 which controls the collector current (which is the current through the bulbs) of transistor V2046. The illumination circuit is not short-circuit proof.

3.2.11. Calibration circuit

The calibration unit is a square-wave generator consisting of an operational amplifier D1901 with feedback.
The oscillator frequency is determined by resistor R1909 and capacitor C1903. Capacitor C1902 keeps point 3 of the IC constantly equal to the average output voltage. Consequently, the generator is independent of fluctuations in the supply voltage. The square-wave amplitude is determined by zener diode V1901.
Potentiometer R1906 allows accurate adjustment of the output voltage and output current.
This output voltage is fed to socket X1 and the output current flows through current loop X2. This is the front panel CAL terminal.
The calibrator output signal can be used for probe compensation and/or checking the vertical deflection accuracy.

3.3. DISMANTLING THE INSTRUMENT

3.3.1. General information

Warning: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.

The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be opened.
If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a skilled person who is aware of the hazard involved.
Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

This section provides the dismantling procedures required for the removal of components during repair operations. All circuit boards removed from the oscilloscope should be adequately protected against damage, and all normal precautions regarding the use of tools must be observed. During dismantling procedures, a careful note must be made of all disconnected leads so that they may be reconnected to their correct terminals during assembly.

The E.H.T. cable is unbreakably connected to the c.r.t. (disconnection at E.H.T. voltage multiplier i.e. unit 15). When the E.H.T. cable to the post-acceleration anode of the c.r.t. is disconnected at the E.H.T. unit end, the E.H.T. cable must be discharged immediately by shortening them to earth.

Damage may result if the instrument is switched on when a circuit board has been removed, or if a circuit board is removed within one minute after switching off the instrument.

3.3.2. Removing the cabinet plates and the screen bezel

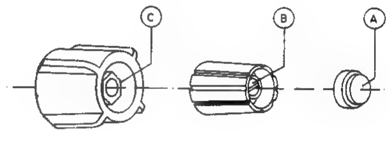
Both upper and lower cabinet plate can be removed after slackening one or two turns the four quick-release fasteners at the corners of each plate. Do not slacken the fasteners more than two turns, otherwise they may come apart.

The screen bezel can be detached by pressing the longer edges and pulling out.

3.3.3. Removing the knobs

3.3.3.1. Single knobs

- Prise off cap A
- Slacken screw (or nut) B
- Pull the knob from the spindle



3.3.3.2. Double knob

- Prise off cap A and slacken screw B
- Pull the inner knob from the spindle
- Slacken nut C and pull the outer knob from the spindle

When fitting a knob or cap, ensure that the spindle is in a position which allows reference lines to be coincident with the markings on the text plate of the oscilloscope.

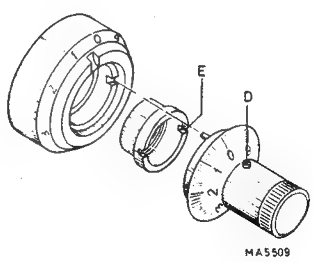


Fig. 3.13. Removing the knobs

3.3.3.3. Delay-time multiplier knob

- Slacken screw D using a hexagonal key and pull the knob from the spindle
- Remove the nut E and withdraw the ring from the spindle.

When fitting the vernier control, turn the spindle of the potentiometer fully anticlockwise. Place the ring on the spindle so that the reference line corresponds to the zero mark on the calibrated scale. Then lock it with nut E. Fit the inner knob so that its cam is engaged with the slot in the ring. Rotate the inner knob until its zero mark coincides with the reference line on the ring. Secure the assembly by tightening screw D.

3.3.4. Removing the circuit boards of: Delay line (unit 4)

Focus unit (unit 7)
Time-base and final X-amplifier (unit 8) (first remove unit 9 and unit 21)
Trigger amplifier (unit 9)
Z-amplifier (unit 11)
Intermediate amplifier (unit 12)
Horizontal final amplifier (unit 21)

These circuit boards can be easily removed after disconnecting the various plug and unscrewing the screws that secure the boards to the chassis. For the intermediate amplifier also unsolder the Delay-line connections

Note: For location of the various p.c. boards, see figures 3.24 and 3.25.

3.3.5. Removing the calibration unit

- Pull off the FOCUS and INTENS knobs
- Remove the lower cabinet plate
- Unplug the two multipole connectors
- Disconnect the single wire connectors
- Unsolder the two LED wires
- Remove the two screws that secure the board to the front panel
- Unscrew the screw which secure the board to the side strip
- Carefully lift the unit out of the oscilloscope.

3.3.6. Removing the circuit board of the final Y amplifier

- Remove the upper cabinet plate
- Remove the two screws which secure the bracket to the side strip
- Disconnect the miniature coaxial plugs
- Unplug the multipole connector
- Remove the delay-line connections
- Disconnect the wires from the C.R.T. pins and carefully lift out the circuit board.

3.3.7. Removing the circuit board of the power supply

- Remove the lower cabinet plate
- Remove the rear plate of the instrument (2 screws)
- Remove the black metal screening plate
- Remove the two screws which secure the circuit board to the rear panel
- Remove the two screws which secure the circuit board to the bottom side of its compartment
- Unplug the three multipole connectors and disconnect the two single-wire connectors to the FOCUS p.c. board (unit 7)
- Disconnect the two single wire connectors to the E.H.T. voltage multiplier (unit 15)
- Carefully withdraw the circuit board from its compartment.

3.3.8. Removing the E.H.T. unit

- Remove the lower cabinet plate
- Remove the black metal screening plate
- Unplug the two single-wire connectors to the power supply board (unit 5)
- Disconnect the E.H.T. connector after unscrewing the swivel nut and discharge the cable
- To extract the E.H.T. unit, swivel out by applying slight pressure to one side of this unit
- Before screwing the E.H.T. cable on to a replacement E.H.T. unit, the E.H.T. connector should be greased with Silicon Dielectric Compound. Order no. 4822 390 20023.

3.3.9. Removing the attenuator unit (see also section 3.3.15)

- Remove the cabinet top and bottom plates.
- Remove the shielding plate at the bottom side of the attenuator (remove 6 screws).
- Unplug the appropriate multipole connectors and coaxial cables.
- Remove the V/DIV attenuator knob.
- Remove the two Allen-key screws, which clamp the attenuator at the bottom side to the frontpanel.
- Remove the two central nuts which clamp the attenuator to the front panel.
- The attenuator can be removed by shifting it backwards and have it leaving the instrument via the bottom side.

3.3.10. Removing the trigger source unit

- Remove the cabinet plates.
- Unplug the four multipole connectors.
- Remove the two hexagon screws that secure the board to the front panel (see also section 3.3.11.).
- Unscrew the two screws at the rear side of the board.
- Unsolder the wires at the components side of the board.
- Unplug the two miniature coaxial plugs at the soldering side of the board.
- Carefully lift the unit out of the oscilloscope.

3.3.11. Replacing a push-button switch

Each of the push-button sets is fitted to the front panel by means of two clamping devices secured by hexagon screws, see Fig. 3.14.

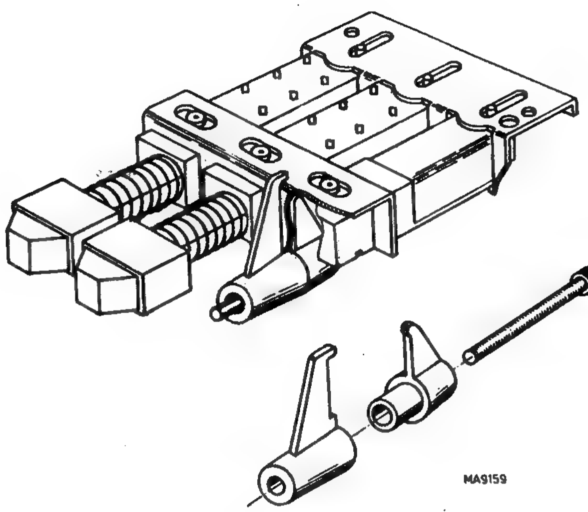


Fig. 3.14. Push-button set clamping device

To remove a push-button switch, the hexagon screws that secure it to the front panel must be removed. To replace one switch-section of a push-button set, refer to Fig. 3.15.

To remove a push-button switch which is mounted on a p.c. board:

- Remove the printed-circuit board for replacing a switch in this unit
- Straighten the 4 retaining lugs of the relevant switch as shown in Fig. 3.15.
- Break the body of the relevant switch by means of a pair of pliers and remove the pieces. The soldering pins are then accessible.
- Remove the soldering pins and clean the holes in the printed-wiring board (e.g. with a suction soldering iron).
- Solder the new switch onto the printed-circuit board.
- Band the 4 retaining lugs back to their original positions.

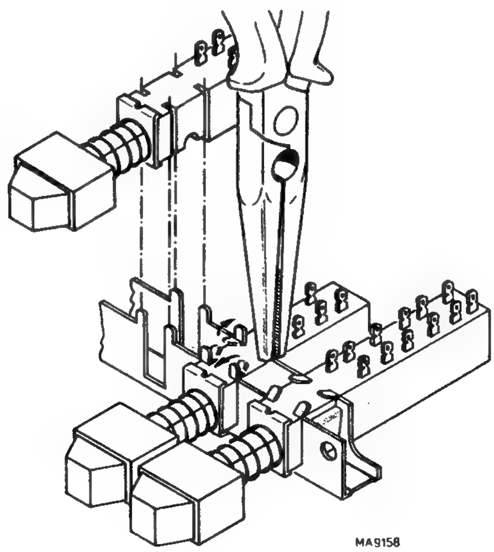


Fig. 3.15. Replacing a switch-segment of a push-button set

Note: Before a push-button switch is refitted to the front panel, it is advisable to stick the two parts of the clamping device together by means of adhesive tape or non-hardening glue, in order to facilitate replacement, refer to Fig. 3.14.

3.3.12. Removing the cathode-ray tube

Attention: Be very careful with the side connections of the c.r.t. If these pins are bent, the c.r.t. is likely to develop a gas leak.

- Remove the upper, lower and rear side instrument covers
- Remove the black coloured metal plate which is screening the focus and the Z-amplifier board
- Remove the bezel by pulling the lower edge
- Slacken the two screws that secure the upper scale illumination lamps support to the front panel
- Remove the tube base
- Slacken the brace round the c.r.t. neck
- Disconnect the E.H.T. cable after unscrewing the swivel nut and discharge the cable.
- Unsolder the screening wire of the E.H.T. cable
- Disconnect the TRACE ROT. wires
- Unplug the connectors on the c.r.t. neck
- Carefully withdraw the c.r.t. through the front panel of the instrument
- If the rubber sleeve around the neck of the c.r.t. must be slid over the neck of a replacement tube, the use of industrial talcum powder is strongly recommended, to prevent the rubber sleeve from sticking on the c.r.t. neck.

3.3.13. Removing the carrying handle

1. Remove the upper and lower cabinet plates
2. Remove the plastic strip which is snapped on to the grip
3. Remove the four screws which secure the grip to the brackets (these screws have been locked with a sealing varnisch).
4. Depress the push-buttons in the brackets and turn the carrying handle as far as possible to the upper side of the oscilloscope
5. Keep the push-button of the right-hand bracket depressed and pull the bracket from its bearing[1)]
6. Remove the grip from the remaining bracket
7. Depress the push-button of the left-hand bracket and turn the latter as far as possible to the lower side of the instrument.
8. Keep the push-button depressed and pull the bracket from its bearing.

If it is impossible to remove the left-hand bracket in this way, remove also its bearing in a similar way as described in footnote 1).

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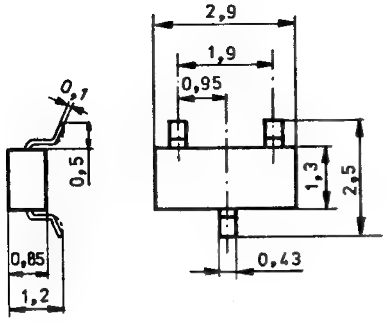
1) With some instruments it may be impossible to remove the handle in the described way. This is due to an extra securing plate in the right-hand bearing. In that case, DO NOT USE FORCE, but work in accordance with the following procedure which replaces points 3, 4 and 5.

   3. Remove the two screws which secure the grip to the right-hand bracket
   4. Remove the two hexagonal bolts which secure the right-hand bearing to the side strip.
   5. Depress the push-button of the right-hand bracket and take the bearing from the bracket.

3.3.14. Soldering micro-miniature semi-conductors



SOT-23 MA9154

Fig. 3.16. Dimensional drawing SOT-23

Because of the small dimensions of these SOT semi-conductors and the lack of space between the components on the printed-circuit board, it is necessary to use a miniature soldering iron with a pin-point tip (max. dia 1 mm) to solder a SOT on to a printed-circuit board.

Working method:

- Carefully unsolder one after the other the soldering tags of the semi-conductor
- Remove all superfluous soldering material. Use a sucking iron or sucking copper litze wire
- Check that the tags of the replacement part are clean and pre-tinned on the soldering places.
- Locate the replacement semi-conductor exactly on its place, and solder each tag to the relevant printed conductor on the circuit board.

NOTE: Bear in mind that the maximum permissible soldering time is 10 seconds during which the temperature of the tags must not exceed 250 deg C. The use of a solder with a low melting point is therefore recommended.

Take care not damage the plastic encapsulation of the SOT during the soldering procedure (softening point of the plastic is 150 ^{o}C).

ATTENTION: When you are soldering inside the instrument it is essential to use a low-voltage soldering iron, the tip of which must be earthed to the mass of the oscilloscope.

Suitable soldering irons are:

- ORYX micro-miniature soldering instrument, type 6A, voltage 6 V, in combination with PLATO pin-point tip type 0-569.
- ERSA miniature soldering iron, type minor 040 B, voltage 6 V.
- Low Voltage Mini Soldering Iron, Type 800/12 W - 6 V, power 12 W, voltage 6 V, order no. 4822 395 10004, in combination with 1 mm-pin-point tip, order no. 4822 395 10012.

3.3.15. Special tools

3.3.15.1. Special tool for the slotted nut of attenuator switches A and B, order no. 5322 395 54023

For those who want to make such a tool, we give a sketch with the dimensions in mm in Fig. 3.17. The material is silversteel N094, tempered 40-45 Rc.

3.3.15.2. Special tool for the slotted nut of the POSITION and LEVEL/SLOPE potentiometers, order no. 5322 395 54024

For those who want to make such a tool, we give a sketch with the dimensions in mm in Fig. 3.18. The material is silversteel N094, tempered 40-45 Rc.

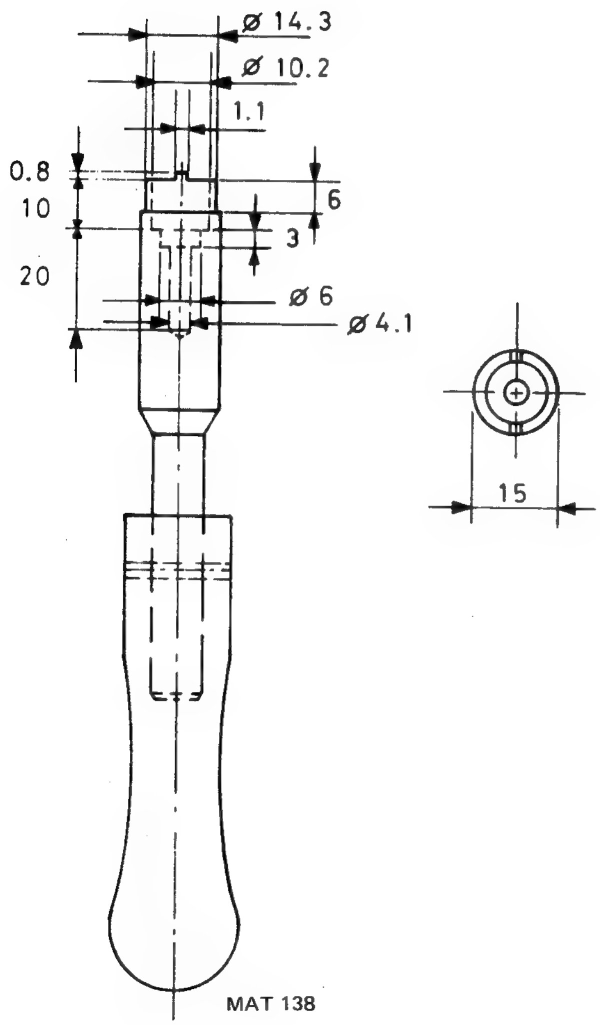


Fig. 3.17. Tool for attenuator unit

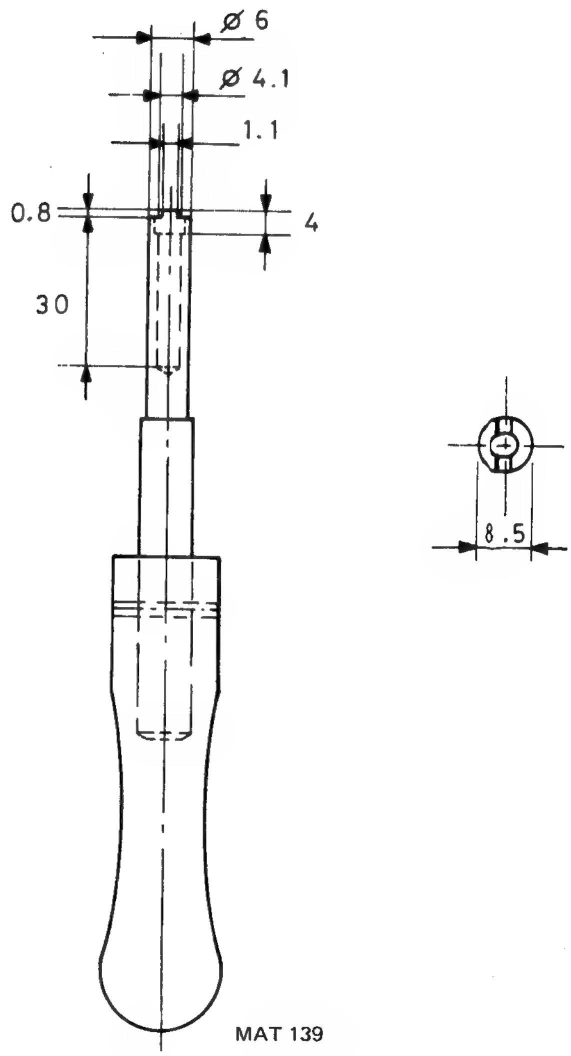


Fig. 3.18. Tool for positioning potentiometer

3.4. CHECKING AND ADJUSTING

3.4.1. General information

The following information provides the complete checking and adjusting procedure for the PM 3262 oscilloscope. As various control functions are interdependent, a certain order of adjustment is often necessary. The procedure is, therefore, presented in a sequence which is best suited to this order, cross-reference being made to any circuit which may affect a particular adjustment.
Before any check or adjustment, the instrument must attain its normal operating temperature. Under average conditions this will be approximately 30 minutes after switching on.

All controls which are mentioned without item numbers are located on the front plate of the oscilloscope.

3.4.2. Recommended test equipment

Required instrument	Specifications	Example of required instrument
Square-wave generator	1Hz – 50MHz Constant amplitude of 10mV–30V, rise–time ⩽ 1n sec duty cycle 50%	——
Sine–wave generator	1Hz – 50MHz Constant amplitude of 10mV–30V	——
Time mark generator	1 sec. –50 n.sec in 23 calibrated positions in a 1-2-5 sequence.	——
Digital multimeter	Wide voltage, current and resistance ranges	Philips PM2527
Variable mains transformer	180V–265V~	Philips 2422 529 00005
Oscilloscope	50MHz	Philips PM3240
Dummy probe	2:1, R= 1MΩ, C= 15pF	see fig. 3.22.
Low capacitance trimming tools		Philips 800NTX

3.4.3. Preliminary control settings and survey of adjusting elements

3.4.3.1. Preliminary control settings

All preset potentiometers and trimming capacitors are indicated on the drawings of the printed-wiring board, see the figures 3.24. and 3.25.

- Push the Y POSITION controls to the NORM position
- Set the switches of the channel A and B signal coupling controls to DC
- Set the DELAY TIME control (R1) to 0 (fully anti-clockwise)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Push the TB MAGN control to position x1.
- Depress push-button AUTO of the trigger mode controls
- Set the MAIN TIME/DIV switch to 1 ms
- Set the DEL'D TIME/DIV switch to OFF
- Set the TIME/DIV vernier controls to CAL
- Depress push-buttons DC of the trigger-coupling controls
- Depress push-buttons A of the trigger-source controls (S21, S22).

3.4.3.2. SURVEY OF ADJUSTING ELEMENTS

ADJUSTMENT AND ADJUSTING SEQUENCE	ADJUSTING ELEMENT	MEASURING VALUES + EXPLANATION	MEASURING INSTRUMENT	CHAPTER	FIGURES
POWER SUPPLY					
Power consumption	-	⩽ 45W	Moving-iron meter	3.4.4.1.	-
+ 12,7V supply voltage	R 1826 (UNIT 5)	+ 12,7V ± 100mV	Digital multimeter	3.4.4.2.	3.24/3.42.
Oscillator frequency	R 1827 (UNIT 5)	+ 12,7V ± 100mV	Digital multimeter	3.4.4.2.1.	3.24/3.42.
Supply voltages unit 12	R 1654 (UNIT 12) R 1673 (UNIT 12)	+ 11,4V − 11,4V	Digital multimeter Digital multimeter	3.4.4.2.2. 3.4.4.2.2.	3.24/3.47 3.24/3.47
Cathode voltage	R 2048 (UNIT 11)	85V ± 3V	Digital multimeter	3.4.4.3.	3.24/3.46.
CALIBRATION SOCKET					
CAL voltage	R 1906 (UNIT 17)	3V ± 1%	Oscilloscope	3.4.5.	3.24/3.50.
CAL frequency	-	2 kHz ± 2%	Oscilloscope	3.4.5.	-
C.R.T. CIRCUIT					
Astigmatism	R 2037 (UNIT 11)	Form of the spot OPTIMUM	-	3.4.6.1.	3.24/3.46.
Focus	R 2074 (UNIT 11)	Mid-position focus potentiometer	Sine-wave generator	3.4.6.1.	3.24/3.46.
Trace rotation	TRACE ROT (R 15 front)	Horizontal trace OPTIMUM	-	3.4.6.2.	-
Orthogonality	R 1737 (UNIT 8)	-	Sine-wave generator	3.4.6.3.	3.19/3.25/3.44.
Geometry	R 2039 (UNIT 8)	Barrel and pin cushion distortion OPTIMUM	Sine-wave generator	3.4.6.4.	3.20/3.25/3.44.
Intensity	R 2071 (UNIT 11)	Barely visible dot at the beginning of the trace.	-	3.4.6.5.	3.24/3.46.
	R 2012 (UNIT 11)	20 mV across R 2087		3.4.6.5.	3.24/3.46
Intensity ratio	R 1537 (UNIT 8)	Barely visible MTB trace and DTB intensified part more brilliant	Sine-wave generator	3.4.6.6.	3.21/3.25/3.44.
BALANCE ADJUSTMENTS					
O-DC Balance	R 124 CH.A. (UNIT 2) R 174 CH.B. (UNIT 2)	Minimum trace jump when switching O-DC Minimum trace jump when switching O-DC	- -	3.4.7.1. 3.4.7.1.	3.24/3.39. 3.24/3.39.
Attenuator balance	R 129 CH.A. (UNIT 2) R 179 CH.B. (UNIT 2)	Minimum trace jump when switching 5V/DIV - 10mV/DIV Minimum trace jump when switching 5V/DIV - 10mV/DIV	- -	3.4.7.2. 3.4.7.2.	3.24/3.39. 3.24/3.39.
Continue balance	R 211 CH.A. (UNIT 12) R 311 CH.B. (UNIT 12)	Minimum trace shift when turning the continuous control Minimum trace shift when turning the continuous control	- -	3.4.7.3. 3.4.7.3.	3.24/3.47. 3.24/3.47.
Balance 5mV/DIV.	R 216 CH.A. (UNIT 12) R 316 CH.B. (UNIT 12)	Minimum trace jump when switching between 5mV/DIV - 10mV/DIV Minimum trace jump when switching between 5mV/DIV - 10mV/DIV	- -	3.4.7.4. 3.4.7.4.	3.24/3.47. 3.24/3.47.
Polarity balance	R 259 CH.A. (UNIT 12) R 359 CH.B. (UNIT 12)	Minimum trace jump when switching Normal-Invert Minimum trace jump when switching Normal-Invert	- -	3.4.7.5. 3.4.7.5.	3.24/3.47. 3.24/3.47.
Trigger balance MTB	R 729 (UNIT 16) R 431 (UNIT 12) R 481 (UNIT 12) R 527 (UNIT 12)	Trace must remain in the screen centre Trace must remain in the screen centre Trace must remain in the screen centre Trace must be written across the centre of the screen	- - - Sine-wave generator	3.4.7.6. 3.4.7.6. 3.4.7.6. 3.4.7.6.	3.24/3.49. 3.24/3.47. 3.24/3.47. 3.24/3.47.
Trigger balance DTB	R 1238 (UNIT 9) R 428 (UNIT 12) R 478 (UNIT 12)	d.t.b. LEVEL adjustment Starting point in the centre of the screen Starting point in the centre of the screen	 Sine-wave generator Sine-wave generator	3.4.7.7. 3.4.7.7. 3.4.7.7.	3.25/3.45. 3.24/3.47. 3.24/3.47.
Y position correction	R 658 (UNIT 13) R 500 (UNIT 12) R 500 (UNIT 12)	Trace exactly in the centre of the screen Trace exactly in the centre of the screen Minimum trace jump-ALT. and ADD depressed	-	3.4.7.8. 3.4.7.8. 3.4.7.8.	3.25/3.48. 3.24/3.47. 3.24/3.47.
Time-base MAGN balance	R 1749 (UNIT 8)	No movement starting when operating TB MAGN.	-	3.4.7.9.	3.25/3.44.
TIME-BASE GENERATORS					
MTB time-coefficients	R 1709 (UNIT 8) R 913 (UNIT 8) R 911 (UNIT 8) R 1706 (UNIT 8) C 916 (UNIT 8)	1 ms range 5 ms range 1 μs range TB MAGNIFIER 0,1 μs range	Time-marker generator Time-marker generator Time-marker generator Time-marker generator Time-marker generator	3.4.8.1. 3.4.8.1. 3.4.8.1. 3.4.8.1. 3.4.8.1.	3.25/3.44. 3.25/3.44. 3.25/3.44. 3.25/3.44. 3.25/3.44.
DTB time-coefficients	R 1326 (UNIT 8) R 1318 (UNIT 8) R 1321 (UNIT 8) C 1311 (UNIT 8)	1 ms range 5 ms range 1 μs range 0,1 μs range	Time-marker generator Time-marker generator Time-marker generator Time-marker generator	3.4.8.2. 3.4.8.2. 3.4.8.2. 3.4.8.2.	3.25/3.44. 3.25/3.44. 3.25/3.44. 3.25/3.44.
Delay time	R 1384 (UNIT 9) R 1379 (UNIT 9)	Start Stop	Time-marker generator Time-marker generator	3.4.8.3. 3.4.8.3.	3.25/3.45. 3.25/3.45.
ALT TB and trace separation	TRACE SEP (R6 front)	Distance between traces 0 DIV. Distance between traces 4 DIV.	-	3.4.8.4.	-

ADJUSTMENT AND ADJUSTING SEQUENCE	ADJUSTING ELEMENT	MEASURING VALUES + EXPLANATION	MEASURING INSTRUMENT	CHAPTER	FIGURES
L.F.CORRECTION AND SENSITIVITIES.					
L.F. correction amplifier (attenuator unit)	R 132 CH.A. (UNIT 2)	Check that the pulse top is straight	Square-wave generator	3.4.9.1.	3.24/3.39.
	R 182 CH.B. (UNIT 2)	Check that the pulse top is straight	Square-wave generator	3.4.9.1.	3.24/3.39.
LF correction MTB external input	R 736 (UNIT 16)	Check that the pulse top is straight	Square-wave generator	3.4.9.2.	3.24/3.49.
LF correction DTB external input	R 1118 (UNIT 16)	Check that the pulse top is straight	Square-wave generator	3.4.9.3.	3.24/3.49.
Gain YA VIA Y	R 654 (UNIT 13)	Adjust for a trace height of 6 DIV.	Square-wave generator	3.4.9.4.	3.25/3.48.
Gain YB VIA Y	GAIN (R13 front)	Adjust for a trace height of 6 DIV.	Square-wave generator	3.4.9.5.	-
Gain at external X Deflection	R 742 (UNIT 16)	Adjust for a trace height of 6 DIV.	Square-wave generator	3.4.9.6.	3.24/3.49.
Gain external triggering via TRIG VIEW.	R 842 (UNIT 9)	Adjust for a trace height of 6 DIV.	Square-wave generator	3.4.9.7.	3.25/3.45.
Gain YA TRIG VIEW	R 413 (UNIT 12)	Adjust for a trace height of 6 DIV ± 3 SUB. DIV.	Square-wave generator	3.4.9.8.	3.24/3.47.
Gain YB TRIG VIEW	R 463 (UNIT 12)	Adjust for a trace height of 6 DIV ± 3 SUB. DIV.	Square-wave generator	3.4.9.9.	3.24/3.47.
Gain YA VIA X	-	Check that the trace width is 6 DIV ± 0,3 DIV	Square-wave generator	3.4.9.10.	-
Gain YB VIA X	-	Check that the trace width is 6 DIV ± 0,3 DIV	Square-wave generator	3.4.9.11.	-
VERTICAL CHANNELS					
Square-wave response (attenuator unit)	C 107 CH.A. (UNIT 2)	Check that pulse top errors do not exceed +/- 3%	Square-wave generator	3.4.10.1.	3.24/3.39.
	C 157 CH.B. (UNIT 2)	Check that pulse top errors do not exceed +/- 3%	Square-wave generator	3.4.10.1.	3.24/3.39.
	C 112 CH.A. (UNIT 2)	Check that pulse top errors do not exceed +/- 3%	Square-wave generator	3.4.10.1.	3.24/3.39.
	C 162 CH.B. (UNIT 2)	Check that pulse top errors do not exceed +/- 3%	Square-wave generator	3.4.10.1.	3.24/3.39.
Input capacitance (attenuator unit)	C 101 CH.A. (UNIT 2)	Check that pulse top errors do not exceed +/- 3%	Square-wave generator and 2 : 1 dummy probe	3.4.10.2.	3.22/3.24/3.39.
	C 151 CH.B. (UNIT 2)	Check that pulse top errors do not exceed +/- 3%		3.4.10.2.	3.22/3.24/3.39.
	C 104 CH.A. (UNIT 2)	Check that pulse top errors do not exceed +/- 3%		3.4.10.2.	3.22/3.24/3.39.
	C 154 CH.B. (UNIT 2)	Check that pulse top errors do not exceed +/- 3%		3.4.10.2.	3.22/3.24/3.39.
	C 109 CH.A. (UNIT 2)	Check that pulse top errors do not exceed +/- 3%		3.4.10.2.	3.22/3.24/3.39.
	C 159 CH.B. (UNIT 2)	Check that pulse top errors do not exceed +/- 3%		3.4.10.2.	3.22/3.24/3.39.
Square-wave response final Y-amplifier	R 634 (UNIT 13)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.3.	3.24/3.25/3.48.
	C 613 (UNIT 13)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.3.	3.24/3.25/3.48.
	R 636 (UNIT 13)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.3.	3.24/3.25/3.48.
	C 614 (UNIT 13)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.3.	3.24/3.25/3.48.
Square-wave response channel A	R 257 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.4.	3.24/3.47.
	C 229 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.4.	3.24/3.47.
	R 253 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.4.	3.24/3.47.
	R 254 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.4.	3.24/3.47.
	C 227 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.4.	3.24/3.47.
	C 228 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.4.	3.24/3.47.
	C 224 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.4.	3.24/3.47.
	R 244 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.4.	3.24/3.47.
	C 233 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.4.	3.24/3.47.
	R 646 (UNIT 13)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.4.	3.24/3.47.
Square-wave response channel B	R 357 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.5.	3.24/3.47.
	C 329 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.5.	3.24/3.47.
	R 253 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.5.	3.24/3.47.
	R 254 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.5.	3.24/3.47.
	C 327 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.5.	3.24/3.47.
	C 328 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.5.	3.24/3.47.
	C 324 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.5.	3.24/3.47.
	R 344 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.5.	3.24/3.47.
	C 333 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.5.	3.24/3.47.
Bandwidth check	-	Check for 100 MHz bandwidth	Sine-wave generator	3.4.10.6.	-
Common-mode rejection	-	Check according to table	Sine-wave generator	3.4.10.7.	-
Dynamic range and position range	-	Check distortion	Sine-wave generator	3.4.10.8.	-
Chopped mode	-	Check chopper function	-	3.4.10.9.	-
Alternate mode	-	Check alternate function	-	3.4.10.10.	-

ADJUSTMENT AND ADJUSTING SEQUENCE	ADJUSTING ELEMENT	MEASURING VALUES + EXPLANATION	MEASURING INSTRUMENT	CHAPTER	FIGURES
Square-wave response trigger view via CH.A.	R 409 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.11.	3.24/3.47.
	C 404 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.11.	3.24/3.47.
	C 407 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.11.	3.24/3.47.
	R 411 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.11.	3.24/3.47.
	C 408 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.11.	3.24/3.47.
Square-wave response trigger view via CH.B.	R 459 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.11.	3.24/3.47.
	C 454 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.11.	3.24/3.47.
	C 457 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.11.	3.24/3.47.
	R 461 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.11.	3.24/3.47.
	C 458 (UNIT 12)	Adjust for optimal square-wave response	Square-wave generator	3.4.10.11.	3.24/3.47.
Bandwidth trigger view via channel A (B)	-	Check bandwidth	Sine-wave generator	3.4.10.12.	-
Bandwidth trigger view via external input	-	Check bandwidth	Sine-wave generator.	3.4.10.13.	-
TRIGGERING					
Trigger slope and level of the MTB	R 881 (UNIT 9)	Starting point trace may not change when operating the +/- SLOPE switch.	Sine-wave generator	3.4.11.1.	3.25/3.45.
	R 845 (UNIT 9)	Check the LEVEL function	Sine-wave generator	3.4.11.1.	-
Trigger sensitivities MTB	-	Check according to table	Sine-wave generator	3.4.11.2.	-
Single sweep operation	-	Check single sweep function	Sine-wave generator	3.4.11.3.	-
Triggering at mains frequency	-	Check for a stable display	-	3.4.11.4.	-
Trigger slope and level of the DTB	-	Starting point trace may not change when operating the +/- SLOPE switch	Sine-wave generator	3.4.11.5.	-
	-	Check the LEVEL function	Sine-wave generator	3.4.11.5.	-
Trigger sensitivities DTB	-	Check according to table	Sine-wave generator	3.4.11.6.	-
JITTER	-	Check for a jitter free display	Square-wave generator	3.4.12.	-
PERIODIC AND RANDOM DEVIATIONS		Check according to table	-	3.4.13.	-
EFFECT OF THE MAINS VOLTAGE VARIATIONS		Check	-	3.4.14.	-
HORIZONRAL AMPLIFIER					
Bandwidth	-	Check bandwidth	Sine-wave generator	3.4.15.1.	-
Phase difference	-	Phase difference less than 3°	Sine-wave generator	3.4.15.2.	-

3.4.4.. Power supply

3.4.4.1. Power consumption

- Check that the voltage has been set to the local mains voltage and connect the instrument to such a voltage
- Switch the oscilloscope on and check that the pilot lamp on the front panel lights up
- Check that the power consumption does not exceed 45W (measured with a moving-iron meter)

3.4.4.2. +12,7V supply voltage (unit 5)

- Check at nominal mains voltage that the voltage on the positive pole of C1831 is +12,7V ± 100mV; if necessary, readjust potentiometer R1826 on the power supply board.
- Check that this voltage does not vary more than ± 50mV when the mains voltage is varied between −10% and +20%.

3.4.4.2.1. Pre-set potentiometer R1827 (FREQ.)

This potentiometer is a factory adjustment control. THE SETTING OF THIS POTENTIOMETER MUST NOT BE DISTURBED UNLESS IT IS ABSOLUTELY IMPOSSIBLE TO SET THE +12,7V WITH THE AID OF POTENTIOMETER R1826.

Adjusting procedure:

- Set the mains input voltage to 220V
- Turn potentiometer R1827 fully anti-clockwise
- Check that the voltage on the positive pole of C1831 is +12,7V ± 100mV; if necessary; readjust potentiometer R1826 on the power supply board.
- Set the mains input voltage to 170V
- Check that the voltage on the positive pole of C1831 is +12,7V ± 100mV; if necessary; readjust potentiometer R1826 on the power supply board.

3.4.4.2.2. Supply voltages for unit 12

- Adjust potentiometer R1654 on unit 12 for a correct +11,4V accross C1653.
- Adjust potentiometer R1673 on unit 12 for a correct −11,4V accross C1661

3.4.4.3. Cathode voltage (unit 11)

- Check that the voltage on test point T4 (unit 11) on the **Z-amplifier board** is 85V ± 3V
- If necessary, readjust potentiometer **R2048** on the Z-amplifier board.

3.4.5. Calibration socket

If necessary, check the supply voltages first, refer to section (3.4.4.).

- Check the calibration square wave on irregularities
- Check that the amplitude of the CAL voltage is 3V ± 1%; if necessary, readjust potentiometer **R1905** on the calibration board (unit 17)
- Check that the frequency of the CAL voltage is 2kHz, ± 2%
- Check that the CAL current is 6mA ± 1%.

3.4.6. Cathode-ray tube circuit

3.4.6.1. Focus and astigmatism (unit 11)

- Check that the controls occupy the positions indicated in section 3.4.3.
- Depress push-button A of the display-mode controls (S1)
- Apply a sine-wave signal at a frequency of 100 kHz to input A
- Adjust the trace height to 6 DIV, using the AMPL switch and vernier
- Set the MAIN TIME/DIV switch and the LEVEL control to such a position that several complete cycles are displayed

- Set the INTENS potentiometer for normal brightness
- Check that an evenly sharp trace can be obtained with the aid of the FOCUS potentiometer. If necessary, readjust potentiometer **R2037** on the **Z amplifier unit**. After this adjustment, the FOCUS potentiometer must be approximately in mid-position. If necessary, this may be corrected by selecting a different value for resistor **R2074** on the Z amplifier unit
- Increase the trace brightness using the INTENS potentiometer
- Check that still a sharp trace may be obtained with the aid of the FOCUS potentiometer. If necesarry, optimize with the aid of **R2037**
- Remove the input signal.

3.4.6.2. Trace rotation

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MAIN TB of the X-deflection controls (S2)
- Centre the time-base line using the POSITION control
- Check that the time-base line runs exactly in parallel with the horizontal graticule lines; if necessary, readjust the TRACE ROT control (R15) on the front panel.

3.4.6.3. Orthogonality (unit 8)

- Depress push-button ALT of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Set the switch of the channel A signal-coupling controls to 0
- Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TB switch to 5 µs
- Set the channel B AMPL switch to 5 mV/DIV and its vernier control to CAL
- Apply a sine-wave voltage of 120mV, frequency 100kHz, to input B
- Depress push-button B of the d.t.b. trigger source controls (S21)
- Adjust the d.t.b. LEVEL control for the triggering of the d.t.b.
- Centre the intensified part of the trace, using the DELAY TIME control (R1).
- Centre the channel A time-base line, using the channel A POSITION potentiometer
- Check that the angle between the horizontal and vertical line is 90°, see fig. 3.19. If necessary, readjust **R1737** on the **time-base board.**

3.4.6.4. Geometry (= barrel and pin cushion distortion) (unit 8)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Apply a sine-wave voltage at a frequency of approx. 100kHz to input A
- Set the channel A signal coupling control to DC
- Set the AMPL./DIV. control of channel A to obtain a trace height of 7,4 DIV.
- Apply a sine-wave voltage at a frequency of approx. 50Hz to input B
- Depress push-button EXT X DEFL of the X deflection controls (S2)
- Depress push-button B of the main time-base trigger-source controls (S22)
- Set the channel B AMPL switch and vernier control to obtain a display width of 9,4 DIV.
- Check that the edges of the display lie within the hatched area shown in fig. 3.20; if necessary, readjust potentiometer **R2039** on the **time-base board**
- Remove the input signals

3.4.6.5. Intensity (unit 11)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button DEL'D TB of the X deflection controls (S2)
- Turn the INTENS potentiometer clockwise
- Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TIME/DIV switch to 1 µs
- Set the switch of the signal-coupling control of channel A to O
- Depress push-button MAIN TB of the delayed time-base trigger-source controls
- Check that there is a barely visible dot at the beginning of the trace. If necessary, readjust potentiometer **R2071** on the **Z amplifier board**

- Resistor R2012 will be a "select in test" resistor of 7k15 .... 15k.
  Adjust the intensity (beam current) in such a way that the voltage accross R2087 lies, between 10mV and 20mV. Adjust if possible for 20mV accross R2087. In case that the dead angle of R16 will be to great (more than 120^{o}), a different value for R2012 must be selected. Repeat this procedure after replacement of a C.R.T.

3.4.6.6. Intensity ratio (unit 8)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Turn the DELAY TIME control (R1) to 5.0 (mid-position)
- Set the MAIN TIME/DIV switch to .2 ms and the DEL'D TIME/DIV switch to 50 μs
- Set the switch of the channel A signal-coupling control to AC
- Apply a sine-wave signal at a frequency of 100 kHz to input A
- Set the display-height to 6 DIV
- Set the INTENS potentiometer to a position 90^{o} from the anti clockwise stop; see Fig. 3.21.
- Check that the trace of the main time-base generator is barely visible over the entire screen and that the part determined by the delayed time-base generator is more brilliant. If necessary, readjust potentiometer **R1537** on the **time-base board**

3.4.7. Balance adjustments

The adjustments of the vertical channels A and B are identical.
The knobs, sockets and adjusting elements of channel B are shown in brackets after those of channel A.
The balance adjustments influence one another and must, therefore, be readjusted in the order in which they are described.

3.4.7.1. 0-DC Balance (Attenuator unit)

- Depress push-button A (B) of the display-mode controls (S1)
- Set the channel A (B) AMPL switch to 5 mV/DIV and the vernier control to CAL.
- Centre the time-base line, using the POSITION potentiometers
- Set the channel A (B) signal coupling switch from 0 to DC
- Check that the trace does not jump; if necessary, readjust potentiometer R124 (Ch. A) or R174 (Ch. B) on the **attenuator board.**

3.4.7.2. Attenuator balance (Attenuator unit)

- Depress push-button A (B) of the display-mode controls (S1)
- Set the switches of the channel A (B) signal-coupling controls to 0
- Centre the time-base line, using the POSITION controls
- Turn the AMPL switch between 5 V/DIV and 10 mV/DIV
- Check that the trace does not jump more than 0,1 DIV; if necessary, readjust potentiometer R129 (Ch. A) or R179 (Ch. B) on the **attenuator board.**

3.4.7.3. Continue balance (Unit 12)

- Depress push-button A (B) of the display-mode controls (S1)
- Set the switches of the channel A (B) signal-coupling controls to 0
- Rotate the channel A (B) AMPL vernier control between minimum and maximum
- Check that the trace does not move more than 1 DIV in the 2 mV/DIV position, 0,4 DIV in the 5 mV/DIV position and 0,2 DIV in the other attenuator positions; if necessary, readjust potentiometer **R211 (R311)** on the **intermediate amplifier board.**

3.4.7.4. Balance 5 mV/div (unit 12)

- Depress push-button A (B) of the display-mode controls (S1)
  Set the switches of the channel A (B) signal-coupling controls to 0
- Centre the time-base line, using the POSITION controls
- Check that the trace does not move more than 1 DIV when the AMPL switch is turned from 5 mV/DIV to
- 2mV/DIV and not more than 0,2DIV in the other positions and when the Ampl./DIV. is turned from 5mV/DIV to 10mV/DIV, minimum trace jumps; if necessary readjust potentiometer **R216 (R316)** on the **intermediate amplifier board.**

3.4.7.5. Polarity (Norm/Invert) balance (unit 12)

- Depress push-button A (B) of the display-mode controls (S1)
- Set the switches of the channel A (B) signal-coupling controls to 0
- Centre the time-base line, using the POSITION controls
- Set the channel A (B) AMPL switch to 10 mV/DIV
- Check that the time-base line does not shift more than 0,3 DIV when the channel A (B) POSITION control is pulled to INVERT; if necessary, readjust potentiometer **R259 (R359)** on the intermediate amplifier board.
- Set the channel A (B) AMPL switch to 2 mV/DIV
- Check that the time-base line does not shift more than 2 DIV, see also section 1.2.2.13., when the channel A (B) POSITION control is pulled to INVERT; if necessary, readjust potentiometer **R259 (R359)** on the **intermediate amplifier board.**

3.4.7.6. Trigger balance main time-base (unit 16, unit 12, unit 9)

- Depress push-button EXT of the m.t.b. trigger-source controls (S22)
- Depress push-button TRIG VIEW of the display-mode controls (S1)
- Depress push-button HF of the m.t.b. trigger-coupling controls (S20)
- Set the m.t.b. LEVEL potentiometer in its mid position.
- Centre the trigger view line with potentiometer R845 on the trigger amplifier p.c. board.
- Depress push-button DC of the m.t.b. trigger-coupling controls (S20)
- Check that the trigger view line remains in the screen centre; if necessary, readjust potentiometer **R729** on the trigger source board
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Check that the trigger view line remains in the screen centre; if necessary, readjust potentiometer **R431** on the **intermediate amplifier board**
- Depress push-button B of the m.t.b. trigger-source controls (S22)
- Check that the trace remains in the screen centre; if necessary, readjust potentiometer **R481** on the **intermediate amplifier board**
- Depress push-button EXT of the m.t.b. trigger-source controls (S22)
- Apply a sine-wave signal of 30 mV, frequency 2 kHz, to the m.t.b. EXT input
- Adjust the m.t.b. LEVEL potentiometer for a triggered display
- Check that the trigger view line is written across the centre of the screen; if necessary, readjust potentiometer **R527** on the **intermediate amplifier board**
- Remove the input signal.

3.4.7.7. Trigger balance delayed time-base (unit 12, unit 9)

- Depress push-button DEL'D TB of the X deflection controls (S2)
- Set the MAIN TIME/DIV switch to .5 μs and its vernier to CAL
- Set the DEL'D TIME/DIV switch to .2 μs and its vernier to CAL
- Depress push-button HF of the d.t.b. trigger-coupling controls
- Depress push-button A of the display-mode controls (S1)
- Set the channel A AMPL switch to 20 mV/DIV and its vernier to CAL
- Depress push-button A of the d.t.b. trigger-source controls (S21)
- Apply a sine-wave voltage of 120 mV, frequency 1 MHz, to input A
- Set the d.t.b. LEVEL potentiometer in its mid position.
- Adjust R1238 on the trigger amplifier p.c. board for a triggered display.
- Centre the display, using the channel A POSITION control
- Shift the starting point of the sine-wave to the central horizontal graticule line, using the d.t.b. LEVEL potentiometer.
- Depress push-button DC of the d.t.b. trigger-coupling controls
- Check that the starting point of the sine-wave remains in the centre of the screen; if necessary, readjust potentiometer **R428** on the intermediate amplifier board.
- Depress push-button B of the display-mode controls (S1)
- Set the channel B AMPL switch to 20 mV/DIV and its vernier to CAL
- Depress push-button HF of the d.t.b. trigger-coupling controls
- Depress push-button B of the d.t.b. trigger-source controls (S21)
- Apply a sine-wave voltage of 120 mV, frequency 1 MHz, to input B
- Centre the display, using the channel B POSITION control

- Shift the starting point of the sine-wave to the central horizontal graticule line, using the d.t.b. LEVEL control.
- Depress push-button DC of the d.t.b. trigger-coupling controls
- Check that the starting point of the sine-wave remains in the centre of the screen; if necessary, readjust potentiometer **R478** on the **intermediate amplifier board**
- Remove the input signal.

3.4.7.8. Y Position correction and ADD balance adjustment. (Unit 12 and 13)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MAIN TB of the X-deflection controls (S2)
- Set the vertical POSITION potentiometer to its mid-position
- Short-circuit the input of the delay-line on the intermediate amplifier board (Unit 12)
- Check that the time-base line is displayed exactly in the centre of the screen; if necessary, readjust potentiometer R658 on the final Y-amplifier board.
- Remove the short-circuit on the intermediate amplifier board
- Depress push-button ALT of the display-mode controls (S1)
- Shift the A and B traces in opposite direction, by means of the POSITION controls.
- Depress push-button ADD of the display-mode controls (S1)
- Readjust potentiometer R500 on the intermediate amplifier so that the trace appears in the centre of the screen.
- Depress push-button ALT of the display-mode controls (S1)
- Shift both traces to the centre of the screen with the POSITION controls
- Depress push-button ADD of the display-mode controls (S1)
- Readjust potentiometer R500 for minimum trace jump
  If necessary, repeat this procedure

3.4.7.9. TB MAGN balance (unit 8)

- Depress push-button MAIN TB of the X deflection controls (S2)
- Depress push-button A of the display-mode controls (S1)
- Move the starting point of the time-base line to the centre of the screen, using the X POSITION control
- Check that the starting point does not move when the TB MAGN control is operated; if necessary, readjust potentiometer **R1749** on the **time-base board.**

3.4.8. Time-base generators

3.4.8.1. Main time-base time coefficients (unit 8)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Depress push-button AUTO of the trigger-mode controls (S8)
- Set the d.t.b. TIME/DIV switch to OFF and its vernier to CAL
- Depress push-button DC of the m.t.b. trigger-coupling controls
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Set the channel A AMPL switch to .1 V/DIV and its vernier to CAL
- Set the switch of the channel A signal-coupling control to DC
- Apply a time-marker signal of 600 mV, pulse repetition rate 1 ms, to the channel A input
- Push the TB MAGN switch to x1
- Set the m.t.b. TIME/DIV switch to 1 ms and its vernier to CAL
- Adjust the m.t.b. LEVEL potentiometer for a stable display.
- Check that the pilot lamps x10 and time-base UNCAL are off
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1709** on the time-base board
- Set the m.t.b. TIME/DIV switch to 5 ms
- Change the repetition rate of the input signal to 5 ms
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R913** on the time-base board
- Set the m.t.b. TIME/DIV switch to 1 μs
- Change the repetition rate of the input signal to 1 μs.
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R911** on the time-base board.

- Pull the TB MAGN switch to x10
- Check that the x10 pilot lamp lights up
- Change the repetition rate of the input voltage to .1 μs
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1706** on the time-base board
- Push the TB MAGN switch to x1
- Set the m.t.b. TIME/DIV switch to .1 μs
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust trimmer capacitor **C916** on the time-base board
- Check that the other positions of the m.t.b. TIME/DIV switch, using the appropriate input signals; tolerance ± 2 % at an ambient temperature of 20 to +30 °C.
- Check that the control range of the m.t.b. TIME/DIV vernier control is 1:2,6 to 1:3,5 and that the pilot lamp UNCAL lights up as soon as the vernier is out of its CAL position.

3.4.8.2. Delayed time-base time coefficients (unit 8)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button DEL'D TB of the X deflection controls (S2)
- Depress push-button AUTO of the trigger-mode controls (S8)
- Depress push-button DC of the d.t.b. trigger-coupling controls
- Rotate the DELAY TIME control (R1) fully anti-clockwise (minimum delay time)
- Push the TB MAGN switch to x1
- Depress push-button A of the d.t.b. trigger-source controls (S21)
- Set the m.t.b. TIME/DIV switch to 2 ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to 1 ms and its vernier to CAL
- Check that the time-base UNCAL lamp is off
- Apply a time-marker signal of 600 mV, repetition rate 1 ms, to the channel A input
- Set the channel A AMPL switch to .1 V/DIV and its vernier to CAL
- Adjust the d.t.b. LEVEL control for a stationnary display
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1326** on the time-base board
- Set the m.t.b. TIME/DIV switch to 10 ms
- Set the d.t.b. TIME/DIV switch to 5 ms
- Change the repetition rate of the input signal to 5 ms
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1318** on the time-base board
- Set the m.t.b. TIME/DIV switch to 2 μs
- Set the d.t.b. TIME/DIV switch to 1 μs
- Change the repetition rate of the input signal to 1 μs
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1321** on the time-base board
- Set the m.t.b. TIME/DIV switch to .2 μs
- Set the d.t.b. TIME/DIV switch to .1 μs
- Change the repetition rate of the input signal to .1 μs
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust trimmer capacitor **C1311** on the time-base board
- Check the sweep times in all other positions of the d.t.b. TIME/DIV switch; tolerance ± 2% in temperature range +20 ... +30 °C. Keep during this check the DELAY TIME control fully anti-clockwise and the m.t.b. TIME/DIV switch one position slower than the d.t.b. TIME/DIV switch.
- Check that the control range of the d.t.b. TIME/DIV vernier control is 1:2,6 to 1:3,5 and that the pilot lamp UNCAL lights up as soon as the vernier is out of its CAL position.

3.4.8.3. Delay time (unit 9)

- Depress push-button A of the display-mode controls (S1)
- Set the switch of the channel A signal-coupling control to DC
- Depress push-button MAIN TB of the X deflection controls (S2)
- Depress push-button AUTO of the trigger-mode controls (S8)
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Depress push-button MAIN TB of the d.t.b. trigger-source controls (S21)
- Push the TB MAGN switch to position x1

- Set the AMPL./DIV of channel A to .1V/DIV and its vernier to CAL
- Set the m.t.b. TIME/DIV switch to .1 ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to .05 μs and its vernier to CAL
- Set the DELAY TIME control (R1) to 1.00
- Apply a time marker voltage with a repetition rate of .1 ms to the channel A input
- Check that the intensified spot on the trace coincides with the starting point of the second time marker pulse; if necessary, readjust potentiometer **R1384** on the trigger amplifier board
- Set the DELAY TIME control (R1) to 9.00
- Check that the intensified spot on the trace coincides with the starting point of the tenth time marker pulse; if necessary, readjust potentiometer **R1379** on the **trigger amplifier board**
- Remove the input signal.

As both adjustments are slightly interdependent, they must be repeated until both conditions are fulfilled.

3.4.8.4. Alternate time-base and trace separation

- Depress push-button A of the display-mode controls (S1)
- Depress push-button ALT TB of the X deflection controls (S2)
- Set the m.t.b. TIME/DIV switch to .5 μs and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to .5 μs and its vernier to CAL
- Set the switch of the channel A signal-coupling control to 0
- Check that the distance between the two traces is 0 DIV with the TRACE SEP control turned anti-clockwise and approximately 4 DIV with this control turned clockwise.

3.4.9. L.F. correction and sensitivities

Before checking the sensitivities, check the balances in accordance with section 3.4.7. Balance adjustments.

3.4.9.1. L.F. correction amplifier (attenuator unit)

- Depress push-button A (B) of the display mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Push the Y POSITION controls to position NORMAL
- Set the channel A (B) signal coupling controls to DC
- Depress push-button A (B) of the m.t.b. trigger-source controls (S22)
- Set the channel A (B) AMPL switch to 10mV/DIV and its vernier to CAL
- Set the m.t.b. TIME/DIV switch to .5ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a square-wave voltage of 60mV, repetition rate 200Hz, to the channel A (B) input
- Check that the pulse top is straight; if necessary, readjust potentiometer R132 (ch. A) or R182 (ch.B) on **the attenuator board.**

3.4.9.2. L.F. correction MTB external input (unit 16)

- Depress push-button TRIG VIEW of the display mode selector S1
- Depress push-button MAIN TB of the horizontal deflection selector S2
- Depress push-button EXT of the MTB trigger source selector S22
- Depress push-button DC of the MTB trigger coupling switch S20
- Set MTB TIME/DIV switch in the 0,1 ms/DIV. position
- Set the DTB TIME/DIV switch in the OFF position
- Apply a 2kHz/600mV square-wave signal to the MTB external input socket X7
- Position the wave form on the screen by means of the MTB level control R7
- Check that the pulse top is straight; if not adjust R736 on the trigger source unit (unit 16)
- Remove the input signal

3.4.9.3. L.F. correction DTB external input (unit 16)

- Depress push-button TRIG VIEW of the display mode selector S1
- Depress push-button MAIN TB of the horizontal deflection selector S2
- Depress push-button EXT of the DTB trigger source selector S21
- Depress push-button DC of the DTB trigger coupling switch S19
- Set the MTB TIME/DIV switch in the 0,1 ms/DIV position
- Set the DTB TIME/DIV switch in the OFF position
- Switch the instrument off and change on unit 9 the coax cables for the MTB and DTB trigger signals from unit 16
- Switch the instrument on again
- Apply a 2kHz/600mV square wave signal to the DTB external input socket X6
- Position the waveform on the screen by means of the MTB level control R7
- Check if the pulse top is straight; if not adjust R1118 on the trigger source unit (unit 16)
- Switch the instrument off and change the coax cables for the MTB and DTB trigger signals again
- Switch the instrument on again
- Remove the input signal

3.4.9.4. Gain (sensitivity) Y_A VIA Y (unit 13)

- Set front panel GAIN potentiometer R12 in its mid position
- Depress push-button A of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Push the Y POSITION controls to position NORMAL
- Set the channel A signal-coupling control to AC
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Set the m.t.b. TIME/DIV to 0,2ms/DIV
- Set the d.t.b. TIME/DIV switch to OFF
- Set the channel A AMPL switch to .5V/DIV and its vernier to CAL
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel A input
- Check that the trace-height is 6 DIV; if necessary, readjust potentiometer **R654** on the **final Y amplifier board.**
- Check that the control range of the channel A AMPL vernier control is 1 : 2,6 to 1 : 3,5 and that the pilot lamp UNCAL lights up as soon as the vernier is out of the CAL position

3.4.9.5. Gain (sensitivity) Y_B VIA Y

- Depress push-button B of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Push the Y POSITION controls to position NORMAL
- Set the channel B signal-coupling control to AC
- Depress push-button B of the m.t.b. trigger-source controls
- Set the d.t.b. TIME/DIV switch to OFF
- Set the channel B AMPL switch to .5V/DIV and its vernier to CAL
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel B input
- Check that the trace height is 6 DIV; if necessary, readjust GAIN potentiometer R13 on the front panel
- Check that the control range of the channel B AMPL vernier control is 1 : 2,6 to 1 : 3,5 and the pilot lamp UNCAL light up as soon as the vernier is out of the CAL position
- Remove the input signal

3.4.9.6. Gain (sensitivity) at external X deflection (unit 16)

- Depress push-button EXT X DEFL of the X deflection controls (S2)
- Depress push-button EXT of the m.t.b. trigger-source controls (S22)
- Set the X AMPL-HOLD OFF control to CAL
- Apply a 300mV square-wave voltage, frequency 2kHz, to the m.t.b. EXT input
- Adjust the X POSITION potentiometer R2 so that there are two points displayed on the screen
- Check that the trace width is 6 DIV; if necessary, readjust potentiometer R742 on the trigger-source board
- Check that the control range of the X AMPL-HOLD OFF control is 1 : 2,6 to 1 : 3,5
- Set the X AMPL-HOLD OFF control to CAL
- Depress push-button EXT ÷ 10 (S22) of the m.t.b. trigger source controls
- Increase the amplitude of the input signal by a factor of 10

- Check that the trace width is 6 DIV ± 2 SUBDIV
- Remove the input signal

3.4.9.7. *Gain (sensitivity) external triggering via TRIG VIEW (unit 9)*

- Depress push-button TRIG VIEW of the display mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Depress push-button EXT of the m.t.b. trigger-source controls (S22)
- Set the m.t.b. TIME/DIV. switch to 0,2m sec.
- Position the waveform in the middle of the screen by means of the m.t.b. LEVEL potentiometer.
- Apply a 600mV square-wave voltage, frequency 2kHz, to the m.t.b. EXT input
- Check that the trace height is 6 DIV; if necessary, readjust potentiometer **R842** on the **trigger amplifier board.**
- Remove the input signal

3.4.9.8. *Gain (sensitivity) Y_A TRIG VIEW (unit 12)*

- Depress push-button TRIG VIEW of the display-mode controls (S1)
- Set the channel A AMPL switch to .5V/DIV and its vernier to CAL
- Depress push-button A (S22) of the m.t.b. trigger-source controls
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel A input
- Set the channel A and B POSITION controls fully anticlockwise
- Centre the trigger - view waveform by means of the m.t.b. LEVEL control R7
- Check that the trace height is 6 DIV; if necessary readjust potentiometer **R413** on the intermediate amplifier board

3.4.9.9. *Gain (sensitivity) Y_B TRIG VIEW (unit 12)*

- Depress push-button TRIG VIEW of the display-mode controls (S1)
- Set the channel B AMPL switch to 0.5V/DIV and its vernier to CAL
- Depress push-button B (S22) of the m.t.b. trigger-source controls
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel B input
- Centre the display, using the m.t.b. LEVEL control R7
- Check that the trace height is 6 DIV; if necessary readjust potentiometer **R463** on the intermediate amplifier board

3.4.9.10. *Gain (sensitivity) Y_A VIA X*

- Depress push-button B of the display-mode controls (S1)
- Depress push-button EXT X DEFL of the X deflection controls (S2)
- Push the Y POSITION controls to position NORMAL
- Set the channel A signal-coupling control to AC
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Set the d.t.b. TIME/DIV switch to OFF
- Set the channel A AMPL switch to .5V/DIV and its vernier to CAL
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel A input
- Adjust the X POSITION potentiometer R2 so that there are two points displayed on the screen
- Position these two points on the middle of the screen by means of the channel B POSITION contro
- Check that the trace width is 6 DIV ± 0,3 DIV

3.4.9.11. *Gain (sensitivity) Y_B VIA X*

- Depress push-button A of the display-mode controls (S1)
- Depress push-button EXT X DEFL of the X deflection controls (S2)
- Push the Y POSITION controls to position NORMAL
- Set the channel B signal-coupling control to AC
- Depress push-button B of the m.t.b. trigger-source controls (S22)
- Set the d.t.b. TIME/DIV switch to OFF
- Set the channel B AMPL switch to .5V/DIV and its vernier to CAL
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel B input

- Adjust the X POSITION potentiometer R2 so that there are two points displayed on the screen.
- Position these two points on the middle of the screen by means of the channel A POSITION control
- Check that the trace width is 6 DIV ± 0,3 DIV.
- Remove the input signal.

3.4.10. Vertical channels

The adjustments of the vertical channels A and B are identical. The knobs, sockets and adjusting elements of channel B are shown in brackets after those of channel A. Before performing the following tests, the balances and sensitivities must be checked in accordance with sections 3.4.7 and 3.4.9.

3.4.10.1. Square-wave response (Attenuator unit)

- Depress push-button A (B) of the display-mode controls (S1)
- Push the Y POSITION controls to NORMAL
- Set the switches of the channel A (B) signal-coupling controls to DC
- Depress push-button A (B) of the m.t.b. trigger-source controls (S22)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Set the m.t.b. TIME/DIV switch to .1ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a square-wave voltage with a frequency of 2kHz rise time ≤ 200 ns, to the channel A (B) input; peak to peak value as indicated in the table below
- Check that the pulse top errors do not exceed +/–3%; if necessary, readjust the relevant trimmers

A (B) AMPL	Y_A (Y_B) input signal	Adjuster	Trace height
2 mV	12 mV	–	6 DIV +/–3 %
5 mV	30 mV	–	6 DIV +/–3 %
10 mV	60 mV	–	6 DIV +/–3 %
20 mV	120 mV	–	6 DIV +/–3 %
50 mV	300 mV	–	6 DIV +/–3 %
.1 V	600 mV	C107 (ch. A) or C157 (ch. B)	6 DIV +/–3 %
.2 V	1,2 V	–	6 DIV +/–3 %
.5 V	3 V	–	6 DIV +/–3 %
1 V	6 V	C112 (ch. A) or C162 (ch. B)	6 DIV +/–3 %
2 V	12 V	–	6 DIV +/–3 %
5 V	30 V	–	6 DIV +/–3 %

- Remove the input signal.

3.4.10.2. Input capacitance (Attenuator unit)

- Depress push-button A (B) of the display-mode controls (S1)
- Push the Y POSITION controls to NORMAL
- Set the switches of the channel A (B) signal-coupling controls to DC
- Depress push-button A (B) of the m.t.b. trigger-source controls (S22)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Set the m.t.b. TIME/DIV switch to .1ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a square-wave voltage with a frequency of 2 kHz, rise time ≤200 ns, to the channel A (B) input via an 2:1 dummy probe, Fig. 3.22.
  (1 Mohm ± 0,1 %//15 pF); peak to peak value as indicated in the table below
- Check that the pulse top errors do not exceed +/–3 %; if necessary, readjust the relevant trimmers.

Into the dummy probe

A (B) AMPL	Y_A (Y_B) input signal	Adjuster	Trace height
2 mV	12 mV	C101 (ch. A) or C151 (ch. B)	3 DIV +/–3 %
5 mV	30 mV	–	3 DIV +/–3 %
10 mV	60 mV	–	3 DIV +/–3 %
20 mV	120 mV	–	3 DIV +/–3 %
50 mV	300 mV	–	3 DIV +/–3 %
100 mV	600 mV	C104 (ch. A) or C154 (ch. B)	3 DIV +/–3 %
.2 V	1,2 V	–	3 DIV +/–3 %
.5 V	3 V	–	3 DIV +/–3 %
1 V	6 V	C109 (ch. A) or C159 (ch. B)	3 DIV +/–3 %
2 V	12 V	–	3 DIV +/–3 %
5 V	30 V	–	3 DIV +/–3 %

– Remove the input signal.

3.4.10.3. *Square-wave response final Y amplifier*

– Depress push-button ALT of the display-mode controls (S1)
– Depress push-buttons A and B (COMP) of the m.t.b. trigger-source controls (S22)
– Depress push-button MTB of the X deflection controls (S2)
– Set the Y POSITION controls to obtain a distance of 6 DIV between both time-base lines (channel A time-base line at the top)
– Set the X Magnifier in the x 1 position
– Remove the main time-base connector from the alternate control pulse socket on the intermediate amplifier board, unit 12, socket 9, fig. 3.24.
– Connect a square-wave with an amplitude of 3V to socket 9 of unit 12
– Both time-base lines will be displayed at a frequency determined by the frequency of the square-wave voltage.

200 Hz (unit 13)

– Set the generator frequency to 200 Hz
– Set the m.t.b. controls to obtain a suitable, triggered display
– Check that the top of the displayed pulse in straight within 2%; if necessary, put R634 in its mid position and select C613 to such a value that the square wave response is optimal.
– Adjust R634 to optimal square wave response.

2 kHz (unit 13)

– Set the generator frequency to 2 kHz
– Set the m.t.b. controls to obtain a suitable, triggered display
– Check that the top of the displayed pulse is straight within 2%; if necessary, put R636 in its mid position and select C614 to such a value that the square wave response is optimal.
– Adjust R636 to optimal square wave response.
– Reconnect socket 9 (Fig. 3.24.).

3.4.10.4. *Square-wave response channel A (unit 12 and 13)*

– Depress push-button A of the display-mode controls (S1)
– Push the Y POSITION controls to the NORM position
– Set the switch of the channel A signal-coupling control to DC
– Set the channel A AMPL switch to 10 mV/DIV and its vernier to CAL
– Set the XMagnifier in the X1 position
– Depress push-button MTB of the Xdeflection controls (S2)
– Depress push-button A of the m.t.b. trigger-source controls (S22)
– Set the m.t.b. TIME/DIV switch to a suitable value
– Set the d.t.b. TIME/DIV switch to OFF
– Apply a square-wave voltage of 60 mV, rise time 1 ns, repetition rate 2 kHz, to the channel A input
– Check that the pulse top is straight within 2% and that the rise time is as short as possible; if necessary readjust potentiometer R257 or select a different value for capacitor C229 on the intermediate Y amplifier adjusting board
– Increase the repetition rate of the input signal to 30 kHz
– Put the instrument in the Magnifier X10 mode for better waveform analysis

- Check that the pulse top is straight within 2% and that the rise time is as short as possible; if necessary, readjust potentiometers R253 and R254 or select a different value for capacitors C227 and C228 on the intermediate Y amplifier adjusting board
- Increase the repetition rate of the input signal to 100 kHz
- Check that the pulse is straight within 2% and that the rise time is as short as possible, if necessary, select capacitor C224 and readjust potentiometer R244 for an optimal result
- Select C233 on the intermediate amplifier (unit 12) to such a value (between 2p2 and 6p8) that the square wave response is optimal
- Set the generator frequency to 30 kHz
- Set the m.t.b. controls to obtain a suitable, triggered display
- Check that the top of the displayed pulse is straight within 2%; if necessary, readjust potentiometer R646 on the Y amplifier board (unit 13)
- Set the generator frequency to 100 kHz
- Set the m.t.b. controls to obtain a suitable, triggered display
- Check that the top of the displayed pulse is straight within 2%; if necessary, select a different value for resistor R646 on the final Y amplifier board
- Check the square-wave response in positions 5 mV/DIV and 2 mV/DIV of the AMPL switch at input voltages of 30 mV and 12 mV. The pulse top aberrations must not exceed 2%
- Pull the channel A Y POSITION control to INVERT
- Repeat the checks described above; the response must be the same and the pulse top aberrations must remain within 2%
- Depress push-button B of the display-mode controls (S1)
- Set the switch of the channel B signal-coupling control to 0
- Set the channel B time-base line in the middle of the screen with the POSITION control (R4)
- Depress push-button A of the display-mode controls (S1)
- Set the switch of the channel A signal-coupling control to 0
- Set the channel A time-base line in the middle of the screen with the POSITION control (R3)
- Set the switch of the channel A signal-coupling control to DC
- Depress push-button ADD of the display-mode controls and check that the response does not change
- Check that the pulse top aberrations remain within ± 2%
- Remove the input signal

3.4.10.5. Square-wave response channel B (unit 12)

- Depress push-button B of the display-mode controls (S1)
- Push the channel A POSITION control to NORM position
- Set the switch of the channel B signal-coupling control to DC
- Set the channel B AMPL switch to 10 m V/DIV and its vernier to CAL
- Set the XMagnifier in the X1 position
- Depress push-button MTB of the X deflection controls (S2)
- Depress push-button B of the m.t.b. trigger source-controls (22)
- Set the m.t.b. TIME/DIV switch to a suitable value
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a square-wave voltage of 60 mV, rise time 1 ns, repetition rate 2 kHz, to channel B input
- Check that the pulse top is straight within 2% and the rise time is as short as possible; if necessary readjust potentiometer R357 or select a different value for capacitor C329 on the intermediate Y amplifier adjusting board
- Increase the repetition rate of the input signal to 30 kHz
- Put the instrument in the Magn X10 mode for better waveform analysis
- Check that the pulse top is straight within 2% and that the rise time is as short as possible; if necessary, readjust potentiometers R353 and R354 or select a different value for capacitors C327 and C328 on the intermediate Y amplifier adjusting board
- Increase the repetition rate of the input signal to 100 kHz
- Check that the pulse top is straight within 2% and that the rise time is as short as possible; if necessary, select capacitor C324 and readjust potentiometer R344 for an optimal result
- Select C333 on the intermediate amplifier (unit 12) to such a value (between 2p2 and 6p8) that the square wave response is optimal

- Check the square-wave response in position 5 mV/DIV and 2 mV/DIV of the AMPL switch at input voltages of 30 mV and 12 mV. The pulse top aberrations must not exceed 2%
- Pull the channel B POSITION control to INVERT
- Repeat the checks described above; the response must be the same and the pulse top aberrations must remain within 2%
- Depress push-button A of the display-mode control (S1)
- Set the switch of the channel A signal-coupling control to 0
- Set the channel A time-base line in the middle of the screen with the POSITION control (R3)
- Depress push-button B of the display-mode controls (S1)
- Set the switch of the channel B signal-coupling control to 0
- Set the channel B time-base line in the middle of the screen with the POSITION control (R4)
- Set the switch of the channel B signal-coupling control to DC
- Depress push-button ADD of the display-mode and check that the response does not change
- Check that the pulse top aberrations remain within ± 2%
- Remove the input signal

3.4.10.6. Bandwidth

- Depress push-button A (B) of the display-mode controls (S1)
- Push the Y POSITION controls to the NORM position
- Set the channel A (B) AMPL switch to 2 mV/DIV and its vernier to CAL
- Set the switch of the signal coupling control to AC
- Depress push-button MTB of the X deflection controls (S2)
- Push the TB MAGN switch to x1
- Depress push-button AUTO of the trigger-mode controls
- Depress push-button HF of the trigger-coupling controls
- Depress push-button A (B) of the trigger-source controls (S22)
- Set the m.t.b. TIME/DIV switch to 2μs and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a sine-wave voltage of 16 mV_{p-p}, frequency 2 MHz , to the channel A (B) input
- Check that the trace height is 8 DIV
- Increase the frequency of the input signal to 35 MHz
- Check that the trace height is at least 5,6 DIV
- Set the channel A (B) AMPL switch to 5 mV/DIV and its vernier to CAL
- Increase the input voltage to 40 mV_{p-p}, frequency 2 MHz
- Check that the trace height is 8 DIV
- Increase the frequency of the input voltage to 100 MHz
- Check that the trace height is at least 5,6 DIV
- Remove the input signal

3.4.10.7. Common-mode rejection

- Depress push-button A of the display-mode controls (S1)
- Set the channel A time-base line in the middle of the screen with the POSITION control (R3)
- Depress push-button B of the display-mode controls (S1)
- Set the channel B time-base line in the middle of the screen with the POSITION control (R4)
- Set the channel A and B signal-coupling switches to DC
- Push the channel A POSITION control to NORM
- Pull the channel B POSITION control to INVERT
- Set both AMPL controls to 10mV/DIV and their verniers to CAL
- Apply a sine-wave voltage of 240mV_{p-p} simultaneously to the channel A and B inputs
- Depress push-button ADD of the display-mode controls (S1)
- Check the rejection in accordance with the following table
- Set the m.t.b. TIME/DIV. switch to a suitable value.

Note: Adjust the channel A or B AMPL vernier control for minimum trace height.

Input voltage	Frequency	Max. trace height	Rejection factor
240 mV	100 kHz	1,2 SUBDIV	>100
240 mV	2 MHz	1,2 SUBDIV	> 100
240 mV	50 MHz	6 SUBDIV	> 20

- Push the channel B POSITION control to NORM
- Remove the input signal.

3.4.10.8. *Dynamic range and position range*

– Depress push-button A (B)of the display-mode controls (S1)
– Set both AMPL switches to 5mV/DIV and their verniers to CAL
– Depress push-button A (B) of the m.t.b. trigger-source controls (S22)
– Apply a sine-wave signal of 120 mV_{p-p}, frequency 10 kHz, to the channel A (B) input
– Check that the top and bottom parts of the sine-wave signal can be displayed, reasonably undistorted, within the measuring graticule, using the channel A (B) POSITON control
– Remove the input signal.

3.4.10.9. *Chopped mode*

– Depress push-button CHOP of the display-mode controls
– Set the m.t.b. TIME/DIV switch to .2 µs
– Check that there are two time-base lines displayed which can be shifted in relation to each other, using the Y POSITION controls (R3 and R4)

3.4.10.10. *Alternate mode*

– Depress push-button ALT of the display-mode controls
– Set the m.t.b. TIME/DIV switch to 10 µs
– Check that there are two time-base lines displayed which can be shifted in relation to each other, using the Y POSITION controls (R3 and R4)
– Set the m.t.b. TIME/DIV switch to .1 s
– Check that the channels are switched over after every sweep of the time-base voltage.

3.4.10.11. *Square-wave response trigger view via channel A (B) (Unit 12)*

– Depress push-button TRIG VIEW of the display-mode controls
– Push the Y POSITION controls to the NORM position
– Set the switches of the channel A and B signal-coupling controls to DC
– Set both AMPL switches to 10 mV/DIV and their verniers to CAL
– Depress push-button MTB of the X deflection controls
– Depress push-button A (B) of the m.t.b. trigger-source controls
– Set the m.t.b. TIME/DIV switch to a suitable position
– Set the d.t.b. TIME/DIV switch to OFF
– Apply a square-wave voltage of 60 mV, frequency 2 kHz, rise time 1 ns, to the channel A (B) input
– Depress push-button DC of the m.t.b. signal-coupling control (S20)
– Check that the pulse top of the trigger view signal is straight and the rise-time as short as possible
– Increase the repetition rate of the input signal to 30kHz
– Check that the pulse top is straight within 5% and that therise-time is as short as possible, if necessary, readjust potentiometers R409 (R459) and select a different value of the capacitors C404, C407, (C454, C457) on the intermediate amplifier board.
– Increase the repetition rate of the input signal to 100kHz
– Check that the pulse top is straight within 5% and that the rise time is as short as possible; if necessary, readjust potentiometer R411 (R461) and select a different value of the capacitor C408 (C458) on the intermediate amplifier board
– Remove the input signal

3.4.10.12. *Bandwidth trigger view via channel A (B)*

– Depress push-button TRIG VIEW of the display-mode controls (S1)
– Push the Y POSITION controls to NORM position
– Set both AMPL switches to 10 mV/DIV and their verniers to CAL
– Set the switches of the signal-coupling controls to AC
– Depress push-button MTB of the X deflection controls (S2)
– Push the TB MAGN switch to x1
– Depress push-button AUTO of the trigger-mode controls
– Depress push-button HF of the m.t.b. trigger-coupling controls
– Depress push-button A (B) of the m.t.b. trigger-source controls (S22)
– Set the m.t.b. TIME/DIV switch to 2 ms and its vernier to CAL
– Set the d.t.b. TIME/DIV switch to OFF
– Apply a sine-wave voltage of 60 mV_{p-p}, frequency 2 MHz, to the channel A (B) input

- Centre the trigger-view signal by means of the m.t.b. LEVEL control
- Check that the trace height of the trigger view signal is 6 DIV
- Increase the frequency of the input voltage to 50 MHz
- Check that the trace height is at least 4,2 DIV
- Remove the input signal

3.4.10.13. Bandwidth trigger view via external input

- Depress push-button TRIG VIEW of the display-mode controls (S1)
- Depress push-button MTB of the X deflection controls (S2)
- Depress push-button EXT of the m.t.b. trigger-source controls (S22)
- Apply a sine-wave voltage of 600 mV_{p-p}, frequency 2 MHz, to the m.t.b. EXT input
- Check that the trace height is 6 DIV
- Increase the frequency of the input signal to 50 MHz
- Check that the trace height is at least 4,2 DIV
- Remove the input signal.

3.4.11. Triggering

3.4.11.1. Trigger slope and level of the m.t.b. (unit 9)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MTB of the X deflection controls (S2)
- Depress push-button DC of the m.t.b. trigger-coupling controls
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Set the switch of the channel A input-coupling control to DC
- Push the channel A Y POSITION control to the NORM position
- Set the channel A AMPL switch to 20 mV and its vernier to CAL
- Set the m.t.b. TIME/DIV switch to 10 μs and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a sine-wave voltage of 120 mV_{p-p}, frequency 30 kHz, to the channel A input
- Centre the display, using the POSITION control
- Centre the starting point of the sine-wave, using the m.t.b. LEVEL control
- Check that the starting point of the signal does not move when the SLOPE switch is set from + to –; if necessary, readjust potentiometer R881 on the trigger-amplifier board
- Push the SLOPE switch to its + position
- Check that the time-base generator starts on the positive-going edge of the sine-wave and moves upwards when the LEVEL potentiometer is turned clockwise
- Pull the SLOPE switch to its – position
- Check that the time-base generator starts on the negative-going edge of the sine-wave.
- Set the channel A AMPL switch to 5 mV/DIV
- Rotate the m.t.b. LEVEL control fully clockwise and fully anti-clockwise
- Check that in both extreme positions the time-base generator cuts out and that the NOT TRIG'D lamp lights up, if necessary readjust potentiometer R845 on the trigger amplifier
- Increase the amplitude of the input signal to 160 mV_{p-p}
- Rotate the m.t.b. LEVEL control fully clockwise and anti-clockwise
- Check that in both extreme positions the trace remains triggered and that the NOT TRIG'D lamp does not light up
- Remove the input signal.

3.4.11.2. *Trigger sensitivities m.t.b.*

- Depress push-button MTB of the X deflection controls (S2)
- Adjust the m.t.b. LEVEL control for a stationary display
- Set the switches of the signal-coupling controls to DC
- Set the m.t.b. TIME/DIV switch to such a position that a reasonable number of sine waves is written on the screen
- Set the d.t.b. TIME/DIV switch to OFF
- Check the trigger sensitivity in accordance with the table below

Input	Frequency sine wave	Display mode	Trigger mode	Trigger coupling	Trigger source	Trace height/ Volts
				MTB	MTB	
A	20 Hz	A	AUTO	DC	A	0,5 DIV up to 1,5 DIV
A	100 MHz	A	AUTO	DC	A	0,5 DIV up to 1,5 DIV
A	20 Hz	A	TRIG	DC	A	0,5 DIV up to 1,5 DIV
A	100 MHz	A	TRIG	DC	A	0,5 DIV up to 1,5 DIV
A	20 kHz	A	TRIG	LF	A	0,5 DIV up to 1,5 DIV
A	20 kHz	A	TRIG	HF	A	0,5 DIV up to 1,5 DIV
A	100 MHz	A	TRIG	HF	A	0,5 DIV up to 1,5 DIV
B	20 Hz	B	TRIG	DC	B	0,5 DIV up to 1,5 DIV
B	20 kHz	B	TRIG	DC	B	0,5 DIV up to 1,5 DIV
B	100 MHz	B	TRIG	DC	B	0,5 DIV up to 1,5 DIV
A and EXT	20 Hz	A	TRIG	DC	EXT	50 mV up to 150 mV
A and EXT	20 kHz	A	TRIG	DC	EXT	50 mV up to 150 mV
A and EXT	100 MHz	A	TRIG	DC	EXT	50 mV up to 150 mV
A and B	20 kHz	ALT	TRIG	DC	A+B	50 mV up to 150mV

- Remove the input signal

3.4.11.3. *Single-sweep operation*

- Depress push-button A of the display-mode controls (S1)
- Set the channel A AMPL switch to .2 V/DIV and its vernier to CAL
- Depress push-button MTB of the X deflection controls (S2)
- Set the m.t.b. LEVEL control to mid-range
- Set the m.t.b. TIME/DIV switch to .1 s and the vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Depress push-button AUTO of the m.t.b. trigger-mode control (S8)
- Apply a sine-wave signal of 5Hz to the channel A input
- Adjust the trace-height to approximately 6 DIV
- Set the switch of the channel A signal-coupling control to 0
- Push the SINGLE button of the m.t.b. trigger-mode controls (S8)
- Check that the NOT TRIG'D lamp lights up
- Set the switch of the channel A signal-coupling control to AC
- Check that the trace is written once and that the NOT TRIG'D lamp is extinghuished at the end of the sweep
- Remove the input signal.

3.4.11.4. *Triggering at mains frequency*

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MTB of the X deflection controls (S2)
- Depress push-button AUTO of the trigger-mode controls
- Depress push-button DC of the trigger-coupling controls
- Set the m.t.b. TIME/DIV switch to 5 ms and its vernier to CAL
- Depress push-button EXT of the trigger-source controls (S22)
- Apply a mains voltage derived signal to the channel A input
- Adjust the trace height to approx. 3 DIV; the trace must be running
- Depress push-button EXT and EXT ÷ 10 (S22) simultaneously (LINE)
- Check that a stable display can be obtained, using the m.t.b. LEVEL control
- Remove the input signal.

3.4.11.5. *Trigger slope and level of the d.t.b.*

- Depress push-button A of the display-mode controls (S1)
- Depress push-button DEL'D TB of the X deflection controls (S2)
- Depress push-button A of the d.t.b. trigger-source controls (S21)
- Depress push-button DC of the d.t.b. trigger-coupling controls
- Push the channel A Y POSITION control to the NORM position
- Set the channel A AMPL switch to 20 mV/DIV and its vernier to CAL
- Turn the DELAY TIME (R1) control fully anti-clockwise
- Set the m.t.b. TIME/DIV switch to 20 μs and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to 10 μs and its vernier to CAL
- Apply a sine-wave voltage of 120 mV_{p-p}, frequency 30 kHz, to the channel A input
- Centre the display, using the POSITION controls
- Centre the starting point of the sine-wave, using the d.t.b. LEVEL control
- Check that the starting point of the signal does not move when the SLOPE switch is set from + to –
- Push the SLOPE switch to its + position
- Check that the time-base generator starts on the positive-going part of the sine-wave and moves upwards when the d.t.b. LEVEL potentiometer is turned clockwise
- Pull the SLOPE switch to – position
- Check that the time-base generator starts on the negative-going part of the sine-wave
- Set the channel A AMPL switch to 5 mV/DIV and its vernier to CAL
- Rotate the d.t.b. LEVEL control fully clockwise and anti-clockwise
- Check that in both extreme positions the time-base generator cuts out
- Increase the amplitude of the input signal to 160 mV_{p-p}
- Rotate the d.t.b. LEVEL control fully clockwise and anti-clockwise
- Check that in both extreme positions the trace remains triggered.
- Remove the input signal

3.4.11.6. *Trigger sensitivities d.t.b.*

- Depress push-button DEL'D TB of the X deflection controls (S2)
- Adjust the d.t.b. LEVEL control for a stationary display
- Depress push-button AUTO of the m.t.b. trigger-mode controls
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Depress push-buttons DC of the signal-coupling controls of the m.t.b.
- Set the m.t.b. TIME/DIV switch one position lower (longer sweep time) than the d.t.b. TIME/DIV switch
- Set the d.t.b. TIME/DIV switch to such a position that a reasonable number of sine waves is written (not for 20 Hz)
- Check the trigger sensitivity in accordance with the table below

Input	Frequency sine wave	Display mode	Trigger coupling d.t.b.	Trigger source d.t.b.	Trace height Volts
A	20 Hz	A	DC	MAIN TB	0,5 DIV up to 1,5 DIV
A	100 MHz	A	DC	MAIN TB	0,5 DIV up to 1,5 DIV
A	20 Hz	A	DC	A	0,5 DIV up to 1,5 DIV
A	100 MHz	A	DC	A	0,5 DIV up to 1,5 DIV
A	20 Hz	A	LF	A	0,5 DIV up to 1,5 DIV
A	20 kHz	A	LF	A	0,5 DIV up to 1,5 DIV
A	20 kHz	A	HF	A	0,5 DIV up to 1,5 DIV
A	100 MHz	A	HF	A	0,5 DIV up to 1,5 DIV
B	20 Hz	B	DC	B	0,5 DIV up to 1,5 DIV
B	20 kHz	B	DC	B	0,5 DIV up to 1,5 DIV
B	100 MHz	B	DC	B	0,5 DIV up to 1,5 DIV
A and EXT dtb	20 Hz	A	DC	EXT	50 mV up to 150 mV
A and EXT dtb	20 kHz	A	DC	EXT	50 mV up to 150 mV
A and EXT dtb	100 MHz	A	DC	EXT	50 mV up to 150 mV

- Remove the input signal.

3.4.12. Jitter

- Depress push-button A of the display-mode controls (S1)
- Set the DELAY TIME (R1) control to 9.00
- Push the TB MAGN switch to position x1
- Depress push-button DEL'D TB of the X deflection controls (S2)
- Set the d.t.b. TIME/DIV switch to 2 μs and its vernier to CAL
- Set the m.t.b. TIME/DIV switch to 1 ms and its vernier to CAL
- Depress push-button AUTO of trigger-mode controls
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Depress push-button MAIN TB of the d.t.b. trigger-source controls (S21)
- Apply a square-wave voltage for a trace height of 4 DIV, repetition rate 20 μs, to the channel A input
- Adjust the m.t.b. LEVEL control for a stable, triggered display
- Check that the time jitter does not exceed 0,3 DIV
- Depress push-button A of the d.t.b. trigger-source controls (S21)
- Check that a jitter-free display can be obtained, setting the d.t.b. LEVEL control
- Remove the input signal.

3.4.13. Periodic and random deviations

These must be measured only with the cabinet plates fitted

- Inputs of channel A and B open
- Set the switches of the signal-coupling controls of channel A and B to AC
- Set both AMPL switches to 2mV/DIV and their verniers to CAL
- Depress push-button ALT of the display-mode control
- Set the d.t.b. TIME/DIV switch to OFF
- Depress push-button MAIN TB of the X deflection controls (S2)
- Depress push-button AUT of the trigger-mode controls
- Measure the periodic and random deviations in accordance with the following table:

Ripple ¼ SUBDIV at maximum
Noise ¼ SUBDIV at maximum
Microphony ¼ SUBDIV at maximum
Converter interference ¼ SUBDIV at maximum
Instability of the trace ¼ SUBDIV at maximum
Parasitic Z modulation must not be visible

3.4.14. Effect of the mains voltage variations

- Depress push-button CHOP of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Pull the TB MAGN switch to x10
- Set the m.t.b. TIME/DIV switch to 2 ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Depress push-button AUTO of the trigger-mode controls
- Set both AMPL switches to 0.5 V/DIV and their verniers to CAL
- Set the switches of the signal-coupling controls of channel A and B to AC
- Interconnect the CAL socket and inputs A and B
- Vary the mains voltage by + and – 10 %
- Check that neither trace height nor trace width changes and that the briliance remains the same
- Remove the input signal of channel A and B

3.4.15. Horizontal amplifier

3.4.15.1. Bandwidth

- Depress push-button B of the display-mode controls (S1)
- Depress push-button EXT X DEFL of the X deflection controls (S2)
- Push the TB MAGN switch to x1
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Apply a sine-wave voltage of 3 V_{p-p}, frequency 2 kHz, to the channel A input
- Check that the trace width is 6 DIV
- Increase the frequency of the input signal to 2 MHz
- Check that the trace width is at least 4,2 DIV
- Remove the channel A input signal

3.4.15.2. Phase difference

- Depress push-button A (B) of the display-mode controls (S1)
- Push the Y POSITION controls to NORMAL
- Set both AMPL switches to 5 mV/DIV and their verniers to CAL
- Set the switches of the signal-coupling controls of channel A and B to DC
- Depress push-button EXT X DEFL of the X deflection controls (S2)
- Depress push-button A (B) of the m.t.b. trigger-source controls (S22)
- Apply a sine-wave voltage of 30mV_{p-p}, frequency 100kHz, to the channel A (B) input
- Check that the phase difference does not exceed 3° (see Fig. 3.23) in which $\frac{B}{A}$ equals the sine of the phase error angle.

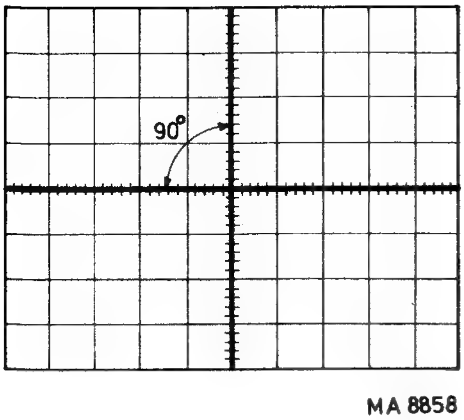


Fig. 3.19. Orthogonality check

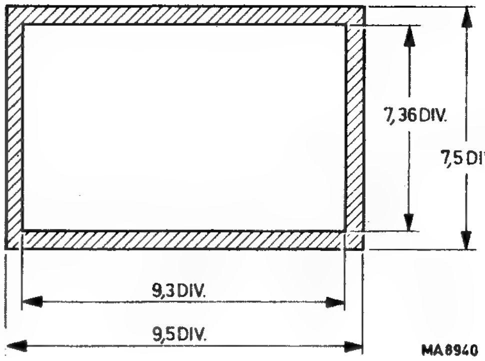


Fig. 3.20. Geometry check

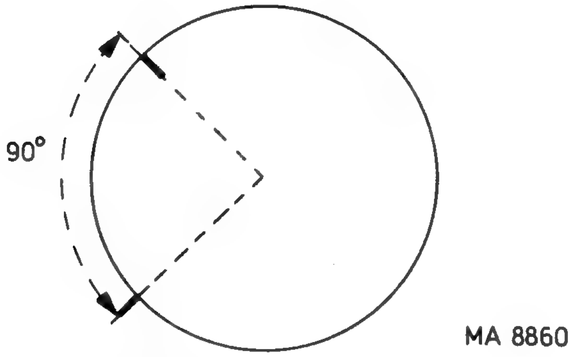


Fig. 3.21. Position of the INTENS potentiometer

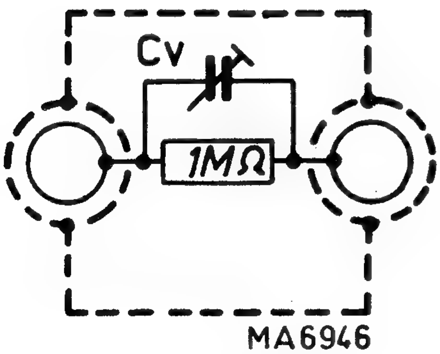


Fig. 3.22. 2:1 Dummy probe

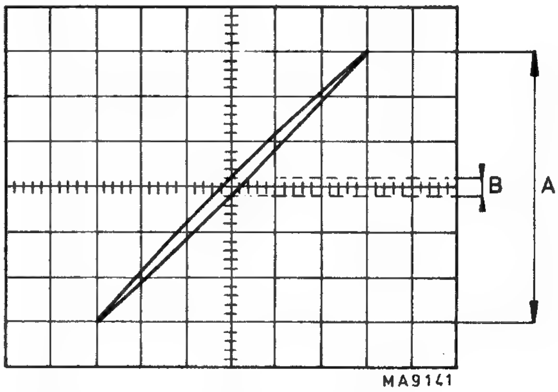


Fig. 3.23. Phase difference in X-Y mode

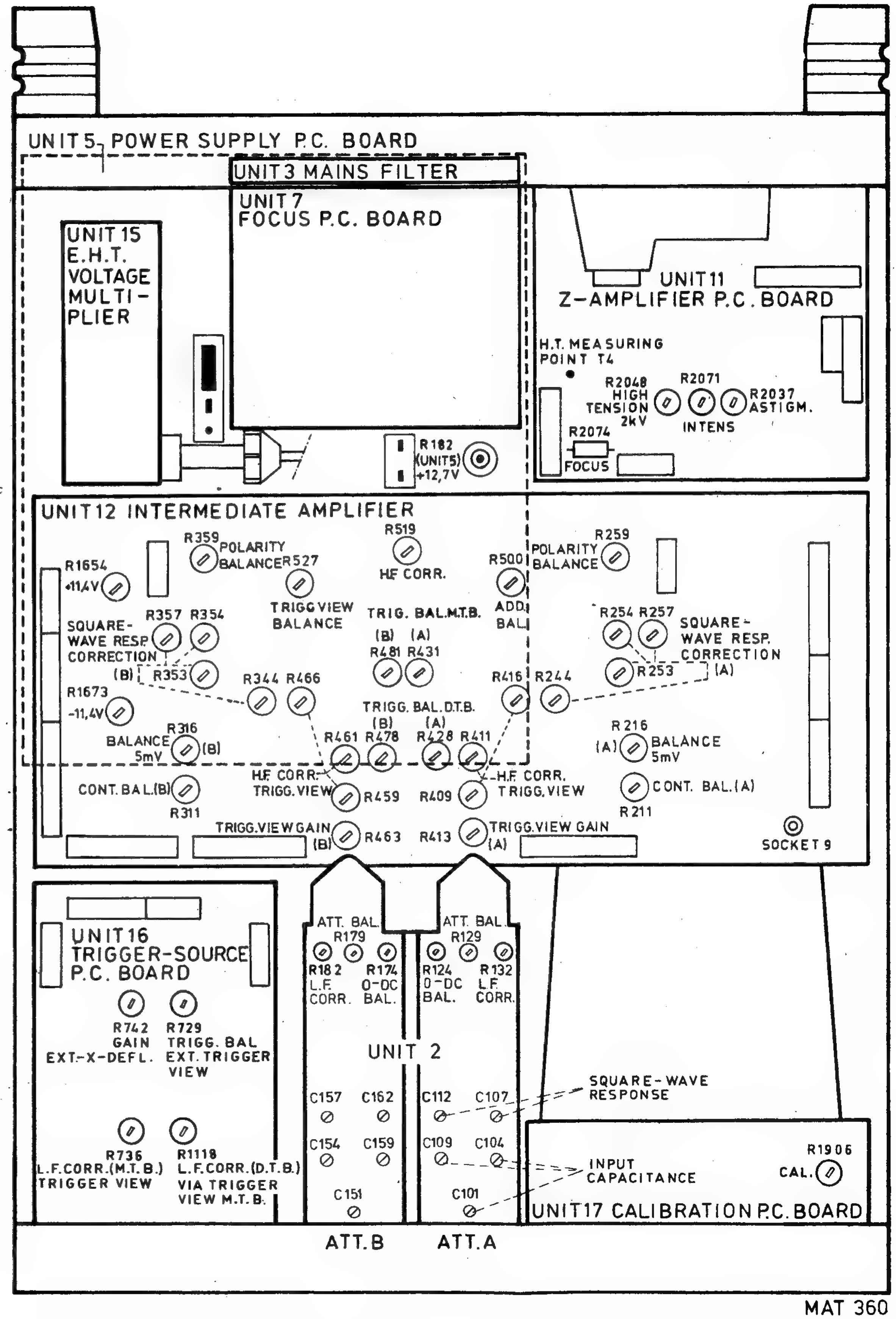


Fig. 3.24. Bottom view with adjusting references.

R634 20
R658 Y-
C616 30
R636 2k
C614 2k
C613 20
R654 G
R646 1C
CORR.

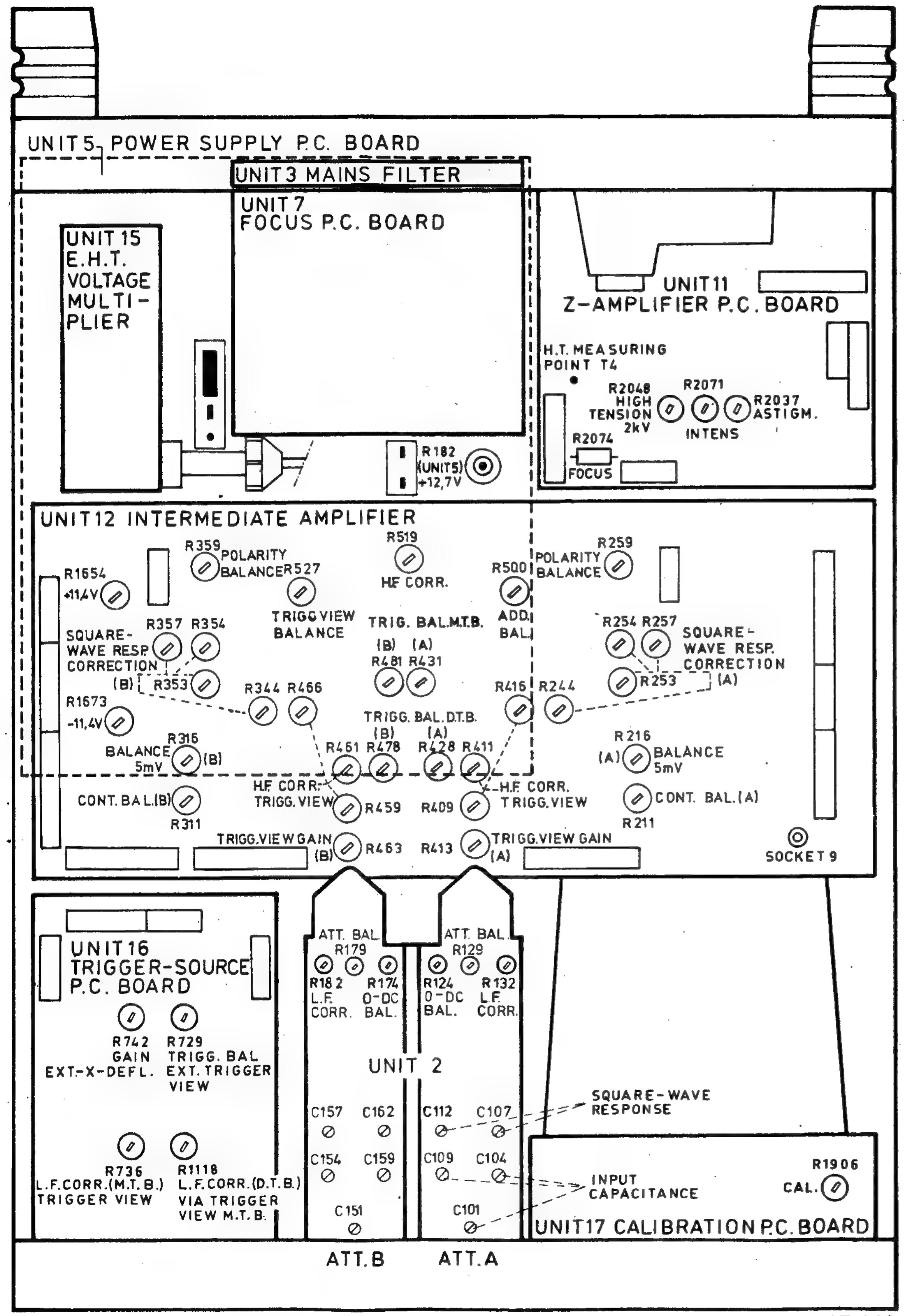


Fig. 3.24. Bottom view with adjusting references.

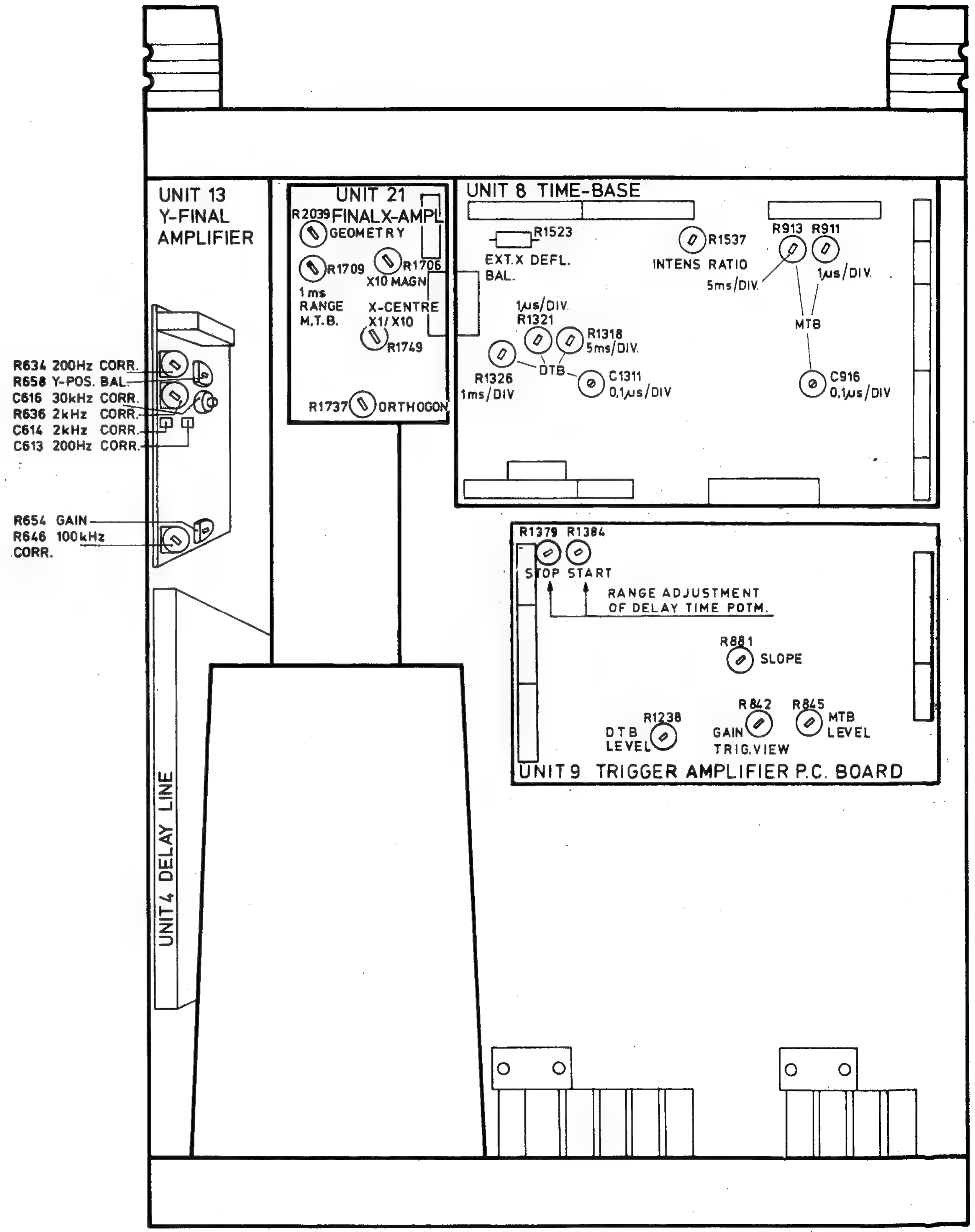


Fig. 3.25. Top view with adjusting references

3.5.

3.5.1.

3.5.1.1.

Fi

3.5. INFORMATION CONCERNING ACCESSORIES

3.5.1. Attenuator probe set delivered with the instrument

This 10x attenuator probe is designed for real time oscilloscopes up to 250 MHz, having a BNC input jack and 13 pF ± 3 pF input capacitance paralleled by 1 MΩ. The PM 8935L is a similar probe with a cable length of 2,5 metres.

3.5.1.1. Specifications

Electrical

Attenuation	10x ± 2 % (Oscilloscope input 1 MΩ ± 1 %)
Input resistance d.c.	10 MΩ ± 2 % (Oscilloscope input 1 MΩ ± 5 %)
a.c.	See curve Fig. 3.26.
Input capacitance d.c. and l.f.	11 pF ± 1 pF (Oscilloscope input 1 MΩ ± 5 % paralleled by 13 pF ± 3 pF)
Input reactance h.f.	See curve Fig. 3.26.
Bandwidth	Probe has negligible effect on oscilloscope bandwidth
Max. input voltage	500 V d.c. + a.c. $_{peak}$, derating with frequency. See Fig. 3.27 Oscilloscope input 1 MΩ and voltage applied between probe tip and earthed part of probe body. Test voltage 1500 $V_{d.c.}$ during 1 s, at a temperature between 15 and 25 °C, a rel. hum. of 80 % at maximum and at sea level.
Check zero button on probe shell	Same function as 0 position of input coupling switch on oscilloscope

Environmental

Probe operates within specifications over the following ranges:

Temperature	–25 °C to +70 °C
Altitude	Up to 5000 metres (15000 feet)
Other environmental data	Same as for the oscilloscope the probe is used with

Mechanical

Dimensions	Probe body 103 mm x 10 mm dia (max.) Cable length 1500 mm or 2500 mm Correction box 55x30x15 mm incl. BNC
Mass	Incl. standard accessories 125 g.

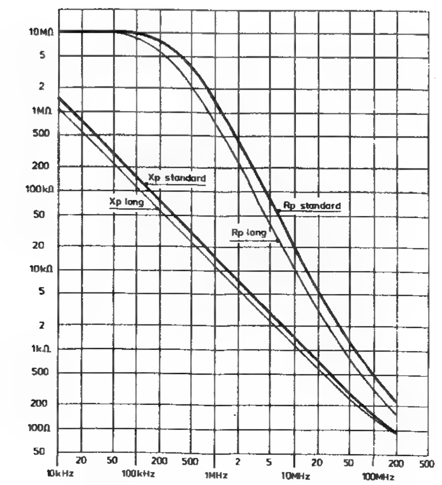


Fig. 3.26. Input resistance (R_p) and reactance (X_p) versus frequency.

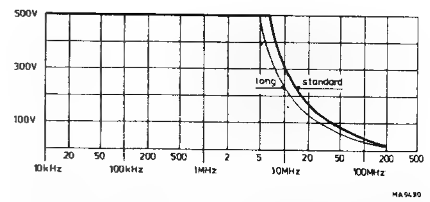
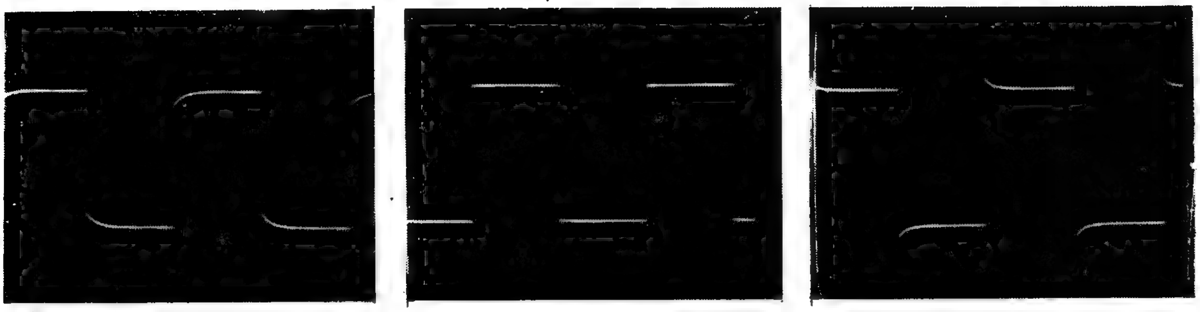


Fig. 3.27. Max. AC component of input voltage as a function of frequency.

3.5.1.2. *Adjustments*

Matching the probe to your oscilloscope

The measuring probe has been adjusted and checked by the manufacturer. However, to match the probe to your oscilloscope, the following manipulation is necessary.
Connect the measuring pin to the CAL socket of the oscilloscope
A trimmer C2 can be adjusted through a hole in the compensation box to obtain optimum square-wave response. See Fig. 3.28.

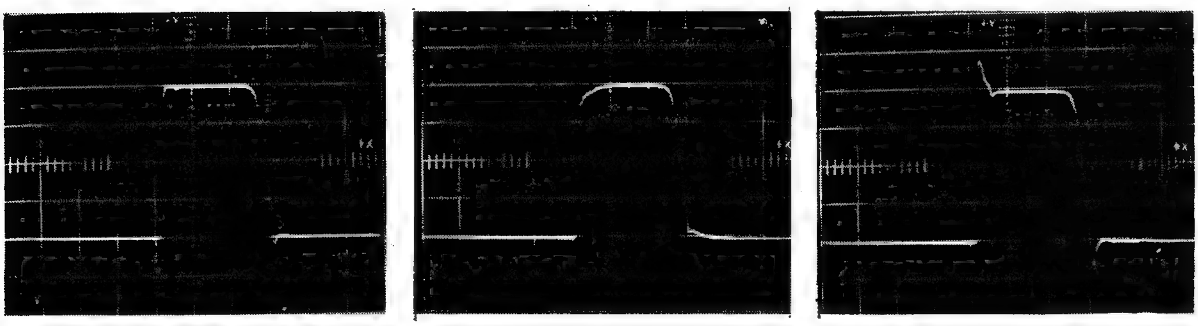


a b c

Fig. 3.28. Adjusting C2

Adjusting the h.f. step response

The h.f. step-response correction network has been adjusted by the manufacturer to match an average oscilloscope input. For optimum pulse response, however, the probe can be adjusted to match your particular oscilloscope. Later readjustment is only necessary if the probe is to be used with a different type of oscilloscope, or after replacement of an electrical component.
For the adjustment, proceed as follows.
Connect the probe to a fast pulse generator (rise time not exceeding 1 ns) which is terminated by its characteristic impedance. Dismantle the compensation box as described in section 3.5.1.3. Set the generator to 100 kHz. Adjust C3, C4, R2, R4 and R5 alternatively to obtain a display as shown in Fig. 3.29.a.
It is important that the leading edge is as steep, and the top is as flat, as possible. Incorrect settings of C3, C4 R2, R4 and R5 give rise to pulse distortions as shown in Fig. 3.29.b. and 3.29.c.



a b c

Fig. 3.29. Adjusting the h.f. step response

3.5.1.3. *Dismantling*

Dismantling the probe (see Fig. 3.30)

The front part 11 of the probe can be screwed from the rear part 13. Item 11 can then be slid from 12 and 13. The RC combination 12 is soldered to 13. For replacement of 12 refer to section 3.5.1.4.

Dismantling the compensation box (see Fig. 3.30)

Unscrew the ribbed collar of the compensation box to the cable. The case 14 can then be slid of the compensation box sideways. The electrical components on the printed-wiring board are then accessible.

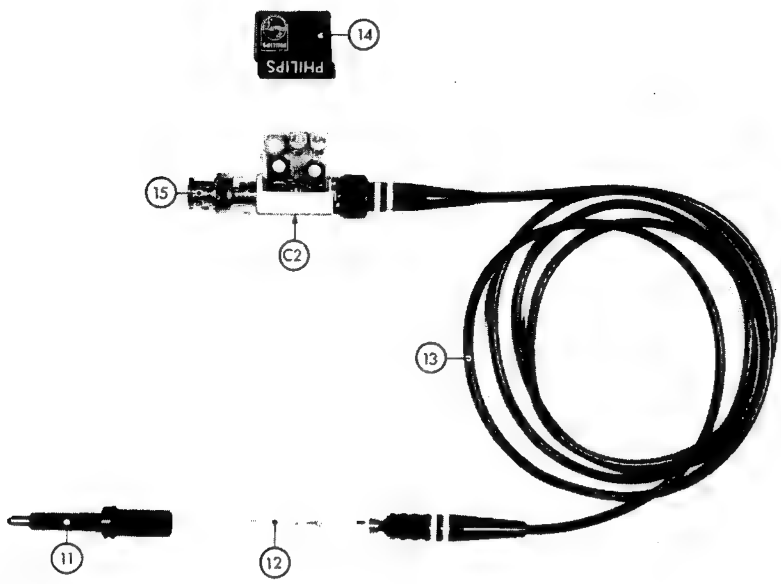


Fig. 3.30. Dismantling

3.5.1.4. *Replacing parts*

Assembling the probe

A new RC network is slid over the cable nipple after which the cable core is soldered on to the resistor wire. When the measuring probe is assembled, the RC network must be at dead centre in the probe tip.

Replacing the cable assembly

Dismantle the compensation box as described in section 3.5.1.3.
Unsolder the connection between the inner conductor and the printed-wiring board. Keep the frame of the compensation box steady and loosen the cable nipple with a 5 mm spanner on the hexagonal part. Replace the cable and fit it working in the reverse order.

Replacing the BNC

Dismantle the compensation box as described in section 3.5.1.3
Unsolder the connection to the printed-wiring board. Keep the frame of the compensation box steady and loosen the BNC with a 3/8 inch spanner. Replace the BNC and fit it working in the reverse order.

Replacing the probe tip

The damaged tip can be pulled out by means of a pair of pliers. A new tip must be firmly pushed in.

3.5.1.5. *Parts lists*

3.5.1.5.1. *Mechanical parts (see Fig. 3.30 and 3.31)*

Item	Order number	Qty	Description
1	5322 321 20223	1	Earth cable
2	5322 256 94136	1	Probe holder
3	5322 255 44026	5	Soldering terminals which may be incorporated in circuits as routine test points
4	5322 532 64223	2	Marking ring red
5	5322 532 64224	2	Marking ring white
	5322 532 64225	2	Marking ring blue (not shown)
6	5322 268 14017	2	Probe tip
7	5322 462 44319	1	Insulating cap to cover metal part of probe during measurements in densely wired circuits
8	5322 462 44318	2	Cap facilitating measurements on dual-in-line integrated circuits
9	5322 264 24018	1	Wrap pin adapter
10	5322 264 24019	1	Spring-loaded test clip
11	5322 264 24021	1	Probe shell with check-zero button
12	5322 216 54152	1	RC network PM 8935
	5322 216 54153	1	RC network PM 8935L
13	5322 320 14063	1	Cable assy PM 8935
	5322 320 14064	1	Cable assy PM 8935L
14	5322 447 64015	1	Cap
15	5322 268 44019	1	BNC connector

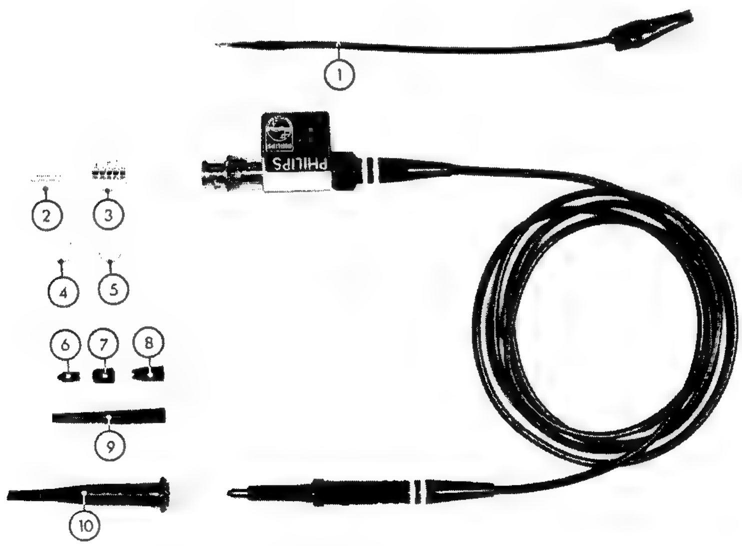
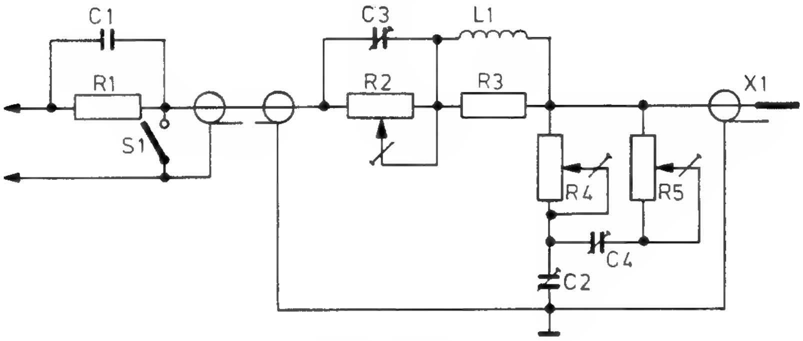


Fig. 3.31. Mechanical parts

3.5.1.5.2. *Electrical parts (Fig. 3.32)*

Item	Order number	Description
C1	–	Part of RC network (not supplied separately)
C2	5322 125 54003	Trimmer 60 pF, 300 V
C3	5322 125 50048	Trimmer 3,5 pF, 300 V, PM 8935
C4	5322 125 50051	Trimmer 18 pF, 300 V
L1	–	Coil (not supplied)
R1	–	Part of RC network (not supplied separately)
R2	5322 100 10135	Potmeter 470 Ω, 20 %
R3	5322 116 50536	Metal film resistor 464 Ω, 1 %, MR25
R4	5322 100 10135	Potmeter 470 Ω, 20 %
R5	5322 100 10143	Potmeter 1 kΩ, 20 %

If a complete new probe is required, type PM 8935 must be ordered.



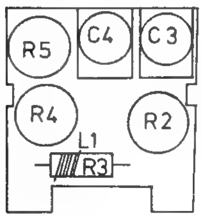


Fig. 3.32. Electrical parts

3.5.2. Adapter PM 9051

This is an adapter to make a BNC socket suitable for the connection of two 4 mm banana plugs.

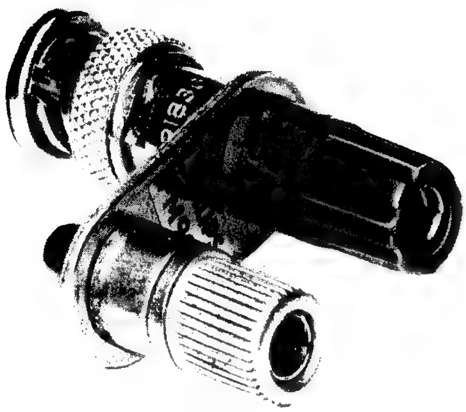


Fig. 3.33. Adapter PM 9051

3.5.3. Trimming Tool Kit (Type 800/NTX)

This useful kit contains 3 twin-coloured holders, 2 extension holders and 21 interchangeable trimming pins.

The wide variety of pins allows almost every type of trimming function to be carried out in instruments to be calibrated (e.g. measuring instruments, radio and T.V. sets).

Ordering number: 4822 310 50015
(A spare set containing the 8 most commonly used pins is available under the Ordering number: 4822 310 50016).

Fig. 3.34. Trimming tool kit

3.6. EXTRA IN-AND OUTPUTS

3.6.1. Introduction

The PM3262 is equipped with a Z-MOD input mounted at the rear panel and with facilities to add two extra outputs with a minimum of components. The output sockets are mounted in the holes already present in the rear panel.

External Z-modulation input

Characteristics:
- DC coupled
- TTL compatible
- "Positive polarity" blanks display
- Response time 35 ns
- Input impedance 10kΩ
- Max. input voltage 50V.

3.6.2. Main time-base gate output (Optionally available)

Characteristics:
- Output voltage 0 ... +5V delivered during MTB sweep
- Output impedance 1kΩ

Fitting the output:
- Fit the connector in the relevant hole in the rear panel of the oscilloscope.
- Connect one end of the coaxial cable to the coax socket MTB gate out on the time-base unit (unit 8): this socket is indicated on the unit lay-out.
  Connect the other end of this cable to the BNC connector on the rear panel.
- Make sure that the coaxial cable is also earthed at the BNC connector end
- BNC connector ordering code 5322 267 10004
- Coax Cable (per meter) ordering code 5322 320 10003

3.6.3. Delayed time-base gate output (Optionally available)

Characteristics:
- Output voltage 0 ... +5V delivered during DTB sweep
- Output impdance 1kΩ

Fitting the output:
- Fit the connector in the relevant hole in the rear panel of the oscilloscope
- Connect one end of the coaxial cable to the coax socket DTB gate out on the time base unit (unit 8): this socket is indicated on the unit lay-out.
  Connect the other end of this cable to the BNC connector on the rear panel.
- Make sure that the coaxial cable is also earthed at the BNC connector end.
- BNC connector ordering code 5322 267 10004
- Coax Cable (per meter) ordering code 5322 267 10003

3.7. MAINTENANCE

The oscilloscope PM 3262 generally requires no maintencance, as the instrument has no components that are subject to wear.
However, to ensure reliable and troublefree operation, the instrument should not be exposed to moisture, heat, corrosive elements or excessive dust.
Cleaning the Nextel suéde coating:

WARNING: The Nextel suéde coating is ethanol-resistant, but is susceptible to methylated spirit, which will attack the surface (due to one of the de-naturing substances).

The bright appearance of the amplifier cabinet, lacquered with Nextel suéde coating will deteriate after some time as the surface becomes soiled . Cleaning with a cloth soaked in water, ethanol or a common household cleansing agent does not always restore this lustre and leaves dirt in the holes and the pores.
The 3M Company have developed a new cleansing pad (White Cleansing Pad, Catalogue No. 8440) which when soaked in water, ethanol or a common household cleansing agent will also penetrate holes and pores.
This method is similar to that of abrasive cleaning pads but lacks their abrasive action. Abrasive cleaning pads should not be used, otherwise surface scratches will result.

3.8. PARTS LIST AND DIAGRAMS
(Subject to alteration without notice)

3.8.1. Mechanical parts (see Fig. 3.37. and 3.38.)

Item	*Qty.*	*Order number*	*Description*	*Used for:*	
1	1	5322 414 34147	Knob with ten turn dial	R1	DELAY TIME
2	5	5322 414 34091	Knob, dia 10 mm, shaft dia 4 mm	R2/S3	POSITION, TB MAGN
2	5	5322 414 74015	Cover, grey with dash	R3/S4	POSITION, PULL TO INVERT A
				R4/S5	POSITION, PULL TO INVERT B
				R5/S6	LEVEL/SLOPE DTB
				R7/S7	LEVEL/SLOPE MTB
3	1	5322 414 34217	Knob, dia 6, 7-10 mm, shaft dia 4 mm	R6	TRACE SEPARATION
3	1	5322 492 64337	Clamping spring		
4	2	5322 414 34081	Knob, dia 24 mm, shaft dia 6 mm	S13/R10/S14	TIME/DIV DTB
4	2	5322 414 34119	Knob, dia 14 mm, shaft dia 4 mm	S15/R11/S16	TIME/DIV MTB
4	2	5322 414 74016	Cover, blue with dash		
5	2	5322 414 34079	Knob, dia 18,7 mm, shaft dia 6 mm	S9/R8/S10	AMPL/DIV A
5	2	5322 414 34091	Knob, dia 10 mm, shaft dia 4 mm	S11/R9/S12	AMPL/DIV B
5	2	5322 414 74029	Cover, blue with dash		
6	3	5322 414 34134	Knob, dia 10 mm	R14/S24	ILLUM/POWER ON-OFF
6	3	5322 492 64337	Clamping spring	R16	INTENS
6	3	5322 414 74015	Cover, grey with dash	R17	FOCUS
7	1	5322 414 34091	Knob, dia 10 mm, shaft dia 4 mm	R18	X-AMPL/HOLD OFF
7	1	5322 414 74028	Skirt		
7	1	5322 414 74015	Cover, grey with dash		
8	1	5322 267 14014	Socket	X1/X2	CAL
8	1	5322 505 14184	Plastic nut		
8	1	5322 405 94073	Current loop		
—	1	5322 263 54003	BNC adapter for CAL socket		
9	5	5322 267 10004	BNC socket	X3	A input
				X4	B input
				X6	DTB EXT TRIG. input
				X7	MTB EXT TRIG. or X DEFL input
				X8	Z-MOD input
10	1	5322 535 80523	Earth socket	X5	
10	1	5322 505 14178	Serrated nut		
11	33	5322 414 14011	Knob	Push-button switches	
12	1	5322 451 34004	Bezel		
13	1	5322 480 34046	Contrast filter, grey		
13	1	5322 480 34074	Contrast filter, blue		
14	1	5322 498 54082	Set grip and brackets	Carrying handle	

Item	Qty.	Order number	Description	Used for:
–	1	5322 447 94169	Front cover, complete	
15	1	5322 447 94574	Upper cabinet plate, complete	
16	1	5322 447 94575	Lower cabinet plate, complete	
17	4	5322 417 24024	Quick fastener, complete	Cabinet plates
18	4	5322 462 44297	Rubber foot	Lower cabinet plate
19	1	5322 447 94503	Rear cabinet plate	
20	4	5322 462 44154	Nylon foot, complete	Rear side
21	1	5322 447 94143	Cast aluminium front plate	
22	1	5322 447 94504	Cast aluminium rear plate.	
23	2	5322 447 94145	Aluminium side strip	Cabinet
–	8	4822 502 30047	Screw	Aluminium side strip
–	–	4822 505 10029	Square nut M3	In aluminium side strip
24	1	5322 321 14066	Mains cable	
25	1	5322 325 64061	Cable cleat	
–	1	4822 253 30025	Fuse, 2 A slow blow	
26	1	5322 256 34019	Fuseholder	
–	–	5322 255 44088	Holder for LED	
–	2	5322 255 24015	Lampholder	
–	6	5322 405 94074	Male clamping piece	Push-button sets
–	6	5322 405 94075	Female clamping piece	Push-button sets
–	6	4822 502 11142	Screw M3x20	Clamping pieces
–	4	5322 462 44153	Rubber clamping buffer	C.R.T. front
–	1	5322 535 94656	Plastic spindle	R14 ILLUM
–	2	5322 505 14185	Special nut	Attenuator switch
–	–	5322 395 54023	Tool	Special attenuator nut
–	4	5322 505 14186	Special nut	LEVEL/SLOPE and POSITION potentiometers
–	–	5322 395 54024	Tool	Above mentioned special nut
–	–	5322 276 14158	Single push-button switch	
–	–	5322 320 14102	Set of coaxial cables	
–	–	5322 268 24116	Coaxial socket, vertically mounted on p.c. boards	
–	–	5322 268 14141	Contact pin for coax. socket	
27	1	5322 455 84075	Textplate	
–	–	4822 390 20023	Grease (Dow Corning "4 Compound" Silicon Dielectric; MIL.S.8660B)	EHT connector
	–	5322 390 34006	Coating (Dow Corning 3140 RTV coating)	FOCUS unit
–	–	4822 266 30071	3-pole plug (Stocko MKF 803-1-0-303)	
–	–	4822 265 30121	3-pole socket (Stocko MKS 823-1-0-303)	
–	–	4822 266 30072	4-pole plug (Stocko MKF 804-1-0-404)	
–	–	4822 265 30119	4-pole socket (Stocko MKS 824-1-0-404)	
–	–	4822 266 30073	6-pole plug (Stocko MKF 806-1-0-606)	
–	–	4822 265 30117	6-pole socket (Stocko MKS 826-1-0-606)	
–	–	4822 266 40057	7-pole plug (Stocko MKF 807-1-0-707)	
–	–	4822 265 40119	7-pole socket (Stocko MKS 827-1-0-707)	
–	1	5322 273 14054	MTB TIME/DIV switch S15	
–	1	5322 273 14055	DTB TIME/DIV switch S15	

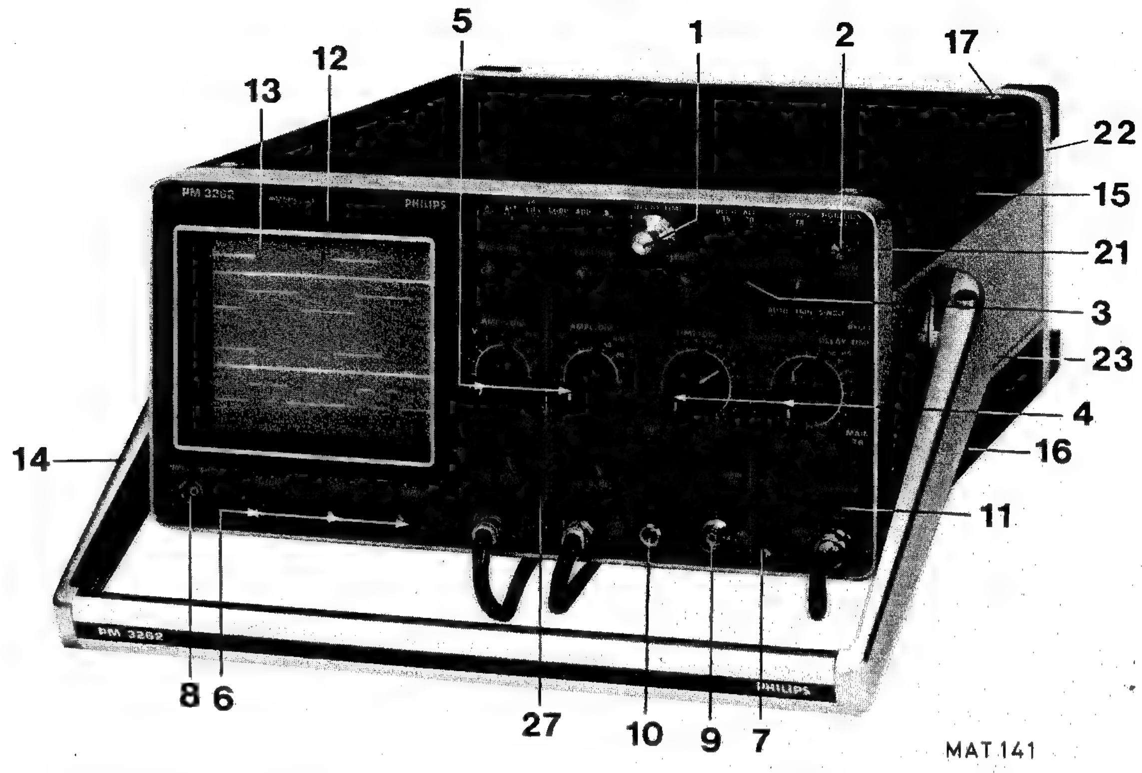


Fig. 3.37. Front view showing itemnumbers

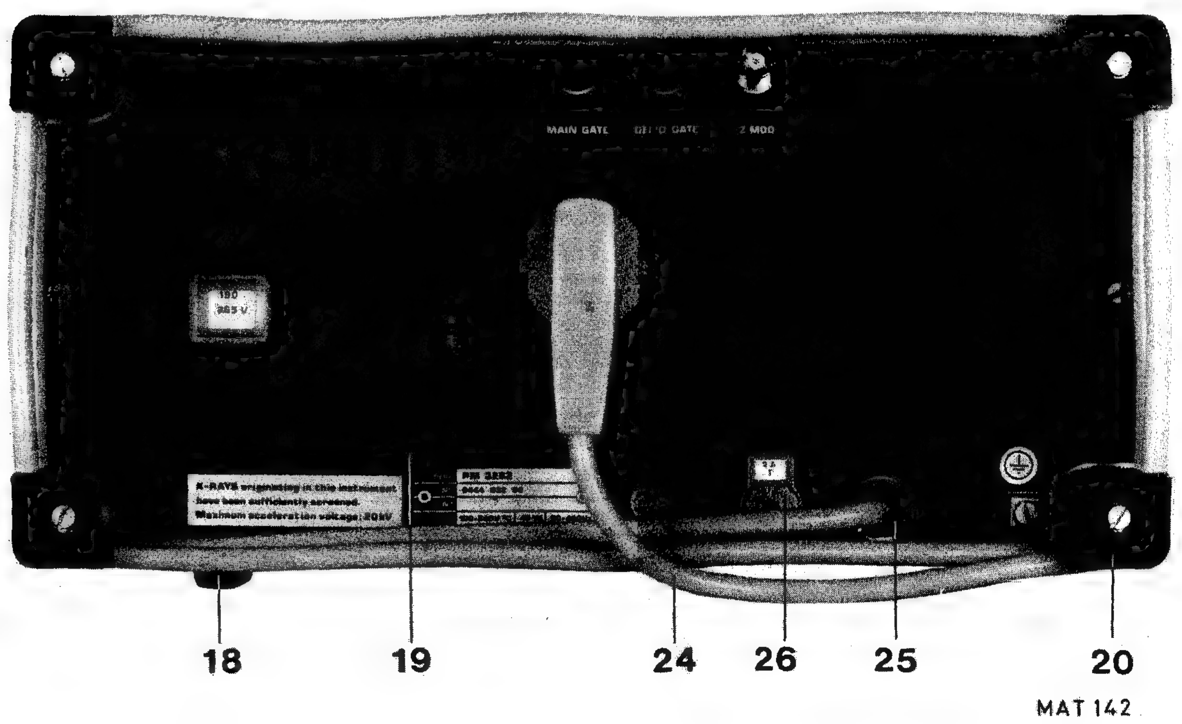


Fig. 3.38. Rear view showing itemnumbers

Item	*Qty.*	*Order number*	*Description*
–	1	5322 219 84135	UNIT 2 Vertical attenuator complete
–	1	5322 216 54202	Vertical attenuator p.c. board
–	1	5322 278 94078	Vertical attenuator internal contact array
–	1	5322 273 34116	Switch segment S9/S11
–	1	5322 121 44262	UNIT 3 Mains filter
–	1	5322 320 44039	UNIT 4 Delay line
–	1	5322 216 54204	UNIT 5 Power supply
–	1	5322 218 64113	UNIT 7 Focus unit
–	1	5322 216 54236	UNIT 8 Main and delayed time-base p.c. board
–	1	5322 216 54225	UNIT 9 Trigger amplifier p.c. board
–	1	5322 216 54203	UNIT 11 Z-amplifier p.c. board
–	1	5322 216 54237	UNIT 12 Intermediate amplifier p.c. board
–	1	5322 216 54197	UNIT 13 Vertical final amplifier p.c. board
–	1	5322 219 84132	UNIT 15 EHT unit
–	1	5322 216 54199	UNIT 16 Trigger source p.c. board
–	1	5322 216 54238	UNIT 17 Calibration generator p.c.board
–	1	5322 216 54239	UNIT 21 Horizontal final amplifier

3.8.2. Electrical parts

3.8.2.1. Item numbers (e.g. C ... R ... V ...) have been divided in groups which relate to the circuit, the unit and the circuit diagram, according the following table.

Item number	**Location**	**Unit number**
1 ... 99	Front or rear plate of the instrument	–
100 ... 199	Y input attenuator and impedance converter	2
200 ... 599	Intermediate amplifier	12
600 ... 699	Final Y amplifier	13
700 ... 799	Ext. input m.t.b.	16
800 ... 899	Trigger circuit m.t.b.	9
900 ... 999	Sweep circuit m.t.b.	8
1000 ... 1099	Time/div. switch m.t.b.	8
1100 ... 1199	Ext. input d.t.b.	16
1200 ... 1299	Trigger circuit d.t.b.	9
1300 ... 1399	Sweep circuit d.t.b.	8
1400 ... 1499	Time/div. switch d.t.b.	8
1500 ... 1549	X Deflection selector	8
1550 ... 1599	Voltage stabilizor (T.B. circuitry)	8
1600 ... 1649	Display-mode logic	12
1650 ... 1699	Voltage stabilizor (intermed. ampl.)	12
1700 ... 1799	Final X amplifier	8
1800 ... 1899	Power supply	5
1900 ... 1999	Calibration generator	17
2000 ... 2099	Final Z amplifier	7, 8, 11, 17

CAPACITORS

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 101	5322 125 54026	3 PF		400	TRIMMER
C 102	4822 121 40278	22 NF	10	400	POLYESTER FOIL
C 103	4822 122 31072	47PF	2	100	CERAMIC PLATE
C 104	5322 125 50048	3,5PF		300	TRIMMER
C 106	4822 122 31191	5,6PF	0,25PF	500	CERAMIC PLATE
C 107	5322 125 50051	18 PF		300	TRIMMER
C 108	5322 122 34105	33 PF	10	50	CERAMIC PLATE
C 109	5322 125 50049	10 PF		300	TRIMMER
C 110	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 111	4822 122 31182	1PF	0,25PF	500	CERAMIC PLATE
C 112	5322 125 50051	18 PF		300	TRIMMER
C 113	5322 122 34113	39 PF	0,5 PF	50	CERAMIC PLATE
C 114	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 117	5322 122 34098	10 NF	20	50	CERAMIC PLATE
C 118	4822 122 30105	1,5PF	0,25PF	100	CERAMIC PLATE
C 119	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 120	4822 122 31038	2,7PF	0,25PF	100	CERAMIC PLATE
C 121	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 122	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 123	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 124	5322 124 14069	6,8UF	-20+20	16	ELECTROLYTIC TANTALUM
C 126	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 127	5322 124 14069	6,8UF	-20+20	16	ELECTROLYTIC TANTALUM
C 128	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 151	5322 125 54026	3 PF		400	TRIMMER
C 152	4822 121 40278	22 NF	10	400	POLYESTER FOIL
C 153	4822 122 31072	47PF	2	100	CERAMIC PLATE
C 154	5322 125 50048	3,5PF		300	TRIMMER
C 156	4822 122 31191	5,6PF	0,25PF	500	CERAMIC PLATE
C 157	5322 125 50051	18 PF		300	TRIMMER
C 158	5322 122 34105	33 PF	10	50	CERAMIC PLATE
C 159	5322 125 50049	10 PF		300	TRIMMER
C 160	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 161	4822 122 31182	1PF	0,25PF	500	CERAMIC PLATE
C 162	5322 125 50051	18 PF		300	TRIMMER
C 163	5322 122 34113	39 PF	0,5 PF	50	CERAMIC PLATE
C 164	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 167	5322 122 34098	10 NF	20	50	CERAMIC PLATE
C 168	4822 122 30105	1,5PF	0,25PF	100	CERAMIC PLATE
C 169	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 170	4822 122 31038	2,7PF	0,25PF	100	CERAMIC PLATE
C 171	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 172	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 173	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 174	5322 124 14069	6,8UF	-20+20	16	ELECTROLYTIC TANTALUM
C 176	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 177	5322 124 14069	6,8UF	-20+20	16	ELECTROLYTIC TANTALUM
C 178	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 201	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 203	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 204	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 206	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 207	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 208	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 209	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 210	4822 122 31038	2,7PF	0,25PF	100	CERAMIC PLATE
C 211	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 212	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 213	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 214	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 216	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 217	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 218	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 219	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 220	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE

C 221	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 222	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 223	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 226	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 230	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 231	4822 122 30098	3,9NF	10	100	CERAMIC PLATE
C 232	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 234	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 236	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 237	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 238	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 239	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 241	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 242	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 243	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 244	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 247	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 248	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 249	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 251	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 301	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 303	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 304	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 306	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 307	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 308	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 309	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 310	4822 122 31038	2,7PF	0,25PF	100	CERAMIC PLATE
C 311	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 312	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 313	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 314	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 316	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 317	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 318	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 319	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 320	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 321	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 322	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 323	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 326	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 330	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 331	4822 122 30098	3,9NF	10	100	CERAMIC PLATE
C 332	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 334	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 336	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 337	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 338	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 339	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 341	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 342	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 343	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 344	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 347	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 348	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 349	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 351	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 400	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 401	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 402	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 403	4822 122 30113	180PF	10	100	CERAMIC PLATE
C 406	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 412	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 413	4822 122 30113	180PF	10	100	CERAMIC PLATE
C 414	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 416	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 417	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 418	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 420	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 422	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE

C 450	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 451	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 452	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 453	4822 122 30113	180PF	10	100	CERAMIC PLATE
C 456	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 462	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 463	4822 122 30113	180PF	10	100	CERAMIC PLATE
C 464	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 466	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 467	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 468	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 470	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 471	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 472	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 502	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 503	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 505	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 506	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 507	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 508	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 509	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 511	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 512	4822 122 30104	1PF	0,25PF	100	CERAMIC PLATE
C 513	4822 122 30104	1PF	0,25PF	100	CERAMIC PLATE
C 514	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 515	4822 124 20468	33UF	-10+50	16	ELECTROLYTIC
C 516	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 517	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 518	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 601	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 602	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 603	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 604	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 605	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC
C 606	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 608	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 609	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 611	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 616	5322 125 50051	18 PF		300	TRIMMER
C 617	4822 122 30113	180PF	10	100	CERAMIC PLATE
C 618	4822 122 30113	180PF	10	100	CERAMIC PLATE
C 620	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 621	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 622	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 623	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 624	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 625	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 626	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 628	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 629	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 700	4822 122 31184	1,5PF	0,25PF	500	CERAMIC PLATE
C 701	4822 122 31194	8,2PF	0,25PF	500	CERAMIC PLATE
C 702	5322 122 34094	82PF	2	100	CERAMIC PLATE
C 703	4822 122 31211	100PF	10	500	CERAMIC PLATE
C 704	4822 121 40407	22 NF	10	400	POLYESTER FOIL
C 705	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 706	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 707	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 708	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 709	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 710	4822 122 31217	3,9PF	0,25PF	500	CERAMIC PLATE
C 711	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 712	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 713	5322 122 34094	82PF	2	100	CERAMIC PLATE
C 714	4822 122 31034	1,8PF	0,25PF	100	CERAMIC PLATE
C 715	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 718	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC
C 801	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 802	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 803	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE

C 804	4822 122 31056	12PF	2	100	CERAMIC PLATE
C 806	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 807	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 808	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 809	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 811	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 812	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 813	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 814	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 816	4822 122 31056	12PF	2	100	CERAMIC PLATE
C 817	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 822	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 823	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 824	4822 122 31056	12PF	2	100	CERAMIC PLATE
C 826	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 829	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 831	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 832	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 833	4822 122 31056	12PF	2	100	CERAMIC PLATE
C 836	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 837	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 838	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 839	4822 122 31069	39PF	2	100	CERAMIC PLATE
C 841	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 842	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 843	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 844	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 846	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 847	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 848	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 849	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 851	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 852	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 853	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 854	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 856	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 857	4822 124 30043	10NF	-20+80	40	CERAMIC PLATE
C 900	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 901	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 903	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 904	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 907	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 908	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 909	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 911	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 912	5322 121 40224	4,7 μF	10	100	POLYESTER FOIL
C 913	5322 121 54108	4,7 NF	1	63	POLYSTYRENE FOIL
C 914	5322 121 54062	4,3 NF	1	63	POLYSTYRENE FOIL
C 915	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 916	5322 125 54003	60 PF		300	TRIMMER
C 917	4822 121 50418	390 PF	1	250	POLYSTYRENE FOIL
C 918	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 919	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 921	4822 124 20707	6,8UF	-10+50	40	ELECTROLYTIC
C 922	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 923	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC
C 924	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 926	4822 121 40438	470 NF	10	100	POLYESTER FOIL
C 927	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 928	4822 122 31164	1,8NF	10	100	CERAMIC PLATE
C 930	4822 122 31173	220PF	10	100	CERAMIC PLATE
C 931	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 932	4822 122 31189	4,7PF	0,25PF	500	CERAMIC PLATE
C 1100	4822 122 31217	3,9PF	0,25PF	500	CERAMIC PLATE
C 1101	4822 122 31211	100PF	10	500	CERAMIC PLATE
C 1102	4822 121 40407	22 NF	10	400	POLYESTER FOIL
C 1103	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1104	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 1106	4822 122 31217	3,9PF	0,25PF	500	CERAMIC PLATE
C 1201	4822 122 31081	100PF	2	100	CERAMIC PLATE

C 1202	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1203	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 1206	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1207	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1208	4822 122 31056	12PF	2	100	CERAMIC PLATE
C 1209	4822 122 31056	12PF	2	100	CERAMIC PLATE
C 1211	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 1212	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1213	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 1214	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 1216	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1217	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 1218	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1219	4822 122 31056	12PF	2	100	CERAMIC PLATE
C 1223	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1224	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 1226	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 1227	4822 122 31056	12PF	2	100	CERAMIC PLATE
C 1228	4822 122 31056	12PF	2	100	CERAMIC PLATE
C 1229	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 1231	4822 122 31056	12PF	2	100	CERAMIC PLATE
C 1232	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 1233	4822 122 31069	39PF	2	100	CERAMIC PLATE
C 1234	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1236	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1237	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1238	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1239	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1301	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1302	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1303	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1304	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1305	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 1306	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1307	5322 121 40224	4,7 µF	10	100	POLYESTER FOIL
C 1308	5322 121 54108	47 NF	1	63	POLYSTYRENE FOIL
C 1309	5322 121 54062	4,3 NF	1	63	POLYSTYRENE FOIL
C 1311	5322 125 54003	60 PF		300	TRIMMER
C 1312	4822 121 50418				POLYSTYRENE FOIL
C 1313	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 1314	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 1315	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 1316	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1317	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 1318	4822 124 20707	6,8UF	-10+50	40	ELECTROLYTIC
C 1319	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1320	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1321	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 1322	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1323	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 1325	4822 122 31222	220PF	2	100	CERAMIC PLATE
C 1326	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 1501	4822 122 31049	6,8PF	0,25PF	100	CERAMIC PLATE
C 1502	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1503	4822 122 31041	3,3PF	0,25PF	100	CERAMIC PLATE
C 1550	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 1551	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 1552	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 1553	4822 122 31174	2,7 NF	10	100	CERAMIC PLATE
C 1554	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1557	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 1559	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1561	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 1562	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 1563	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1564	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1567	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 1569	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1601	4822 122 31243	82PF	2	100	CERAMIC PLATE
C 1602	4822 122 31081	100PF	2	100	CERAMIC PLATE

C 1603	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 1604	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1605	4822 122 31074	56PF	2	100	CERAMIC PLATE
C 1606	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1607	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 1608	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1609	4822 124 20589	220UF	-10+50	10	ELECTROLYTIC
C 1613	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 1614	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 1616	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1617	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1651	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 1652	4822 124 20468	33UF	-10+50	16	ELECTROLYTIC
C 1653	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC
C 1654	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 1655	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1656	4822 124 20468	33UF	-10+50	16	ELECTROLYTIC
C 1657	4822 124 20468	33UF	-10+50	16	ELECTROLYTIC
C 1658	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 1659	4822 124 20468	33UF	-10+50	16	ELECTROLYTIC
C 1661	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC
C 1662	4822 124 20468	33UF	-10+50	16	ELECTROLYTIC
C 1663	4822 124 20468	33UF	-10+50	16	ELECTROLYTIC
C 1664	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 1665	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1701	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1702	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 1704	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 1801	5322 121 44142	220 NF	10	250	POLYESTER FOIL
C 1802	5322 124 44007	220UF	-10+50	350	ELECTROLYTIC
C 1803	5322 124 44007	220UF	-10+50	350	ELECTROLYTIC
C 1804	4822 121 40342	47 NF	10	630	POLYESTER FOIL
C 1806	5322 122 54024	270PF	10	2000	CERAMIC DISK
C 1807	5322 121 44248	30,1 NF	10	500	POLYESTER FOIL
C 1808	5322 121 44248	30,1 NF	10	500	POLYESTER FOIL
C 1809	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1811	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1812	5322 121 54049	3,3 NF	1	63	POLYSTYRENE FOIL
C 1813	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1814	5322 124 24089	10UF	-20+20	16	ELECTROLYTIC
C 1816	5322 124 24089	10UF	-20+20	16	ELECTROLYTIC
C 1817	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 1818	5322 124 24089	10UF	-20+20	16	ELECTROLYTIC
C 1819	5322 124 24099	22UF	-20+20	25	ELECTROLYTIC
C 1821	5322 124 24099	22UF	-20+20	25	ELECTROLYTIC
C 1826	4822 122 31166	560PF	10	500	CERAMIC PLATE
C 1828	5322 124 24212	220UF	-20+20	6,3	ELECTROLYTIC
C 1829	5322 124 24212	220UF	-20+20	6,3	ELECTROLYTIC
C 1831	5322 124 24155	100UF	-20+20	16	ELECTROLYTIC
C 1832	5322 124 24155	100UF	-20+20	16	ELECTROLYTIC
C 1833	4822 121 40456	2,2 µF	10	100	POLYESTER FOIL
C 1834	4822 121 40456	2,2 µF	10	100	POLYESTER FOIL
C 1836	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 1837	4822 121 40411	33 NF	10	250	POLYESTER FOIL
C 1838	4822 121 41134	10 NF	10	250	POLYESTER FOIL
C 1839	5322 124 24089	10UF	-20+20	16	ELECTROLYTIC
C 1841	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 1851	5322 122 54007	220 PF	20	5kV	CERAMIC DISK
C 1852	5322 122 54007	220 PF	20	5kV	CERAMIC DISK
C 1853	5322 122 54007	220 PF	20	5kV	CERAMIC DISK
C 1854	5322 122 54007	220 PF	20	5kV	CERAMIC DISK
C 1856	5322 122 54007	220 PF	20	5kV	CERAMIC DISK
C 1857	5322 122 54007	220 PF	20	5kV	CERAMIC DISK
C 1858	5322 122 54007	220 PF	20	5kV	CERAMIC DISK
C 1859	5322 122 54007	220 PF	20	5kV	CERAMIC DISK
C 1861	5322 122 54007	220 PF	20	5kV	CERAMIC DISK
C 1901	4822 124 20728	10UF	-10+50	63	ELECTROLYTIC
C 1902	5322 121 40233	680 NF	10	100	POLYESTER FOIL
C 1903	4822 121 50611	20 NF	1	63	POLYSTYRENE FOIL
C 1904	4822 124 20728	10UF	-10+50	63	ELECTROLYTIC

C 2001	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 2002	4822 122 31052	8,2PF	0,25PF	100	CERAMIC PLATE
C 2003	4822 122 31052	8,2PF	0,25PF	100	CERAMIC PLATE
C 2004	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 2007	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2009	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 2011	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 2012	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 2013	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2014	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 2015	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 2016	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 2017	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 2018	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 2019	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 2021	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 2022	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2026	5322 122 30134	10NF	-20+50	3K	CERAMIC PLATE
C 2028	5322 122 54007	220 PF	20	5kV	CERAMIC DISK
C 2029	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 2030	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2031	5322 121 54044	1,8 NF	1	63	POLYSTYRENE FOIL
C 2032	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 2033	4822 121 40438	470 NF	10	100	POLYESTER FOIL
C 2034	4822 122 31211	100PF	10	500	CERAMIC PLATE
C 2035	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 2036	4822 121 40366	15 NF	10	1000	POLYESTER FOIL
C 2037	4822 122 31178	680PF	10	500	CERAMIC PLATE
C 2038	5322 122 50044	1NF	-20+50	3K	CERAMIC DISK
C 2039	5322 122 50044	1NF	-20+50	3K	CERAMIC DISK
C 2041	4822 121 41161	100 NF	10	250	POLYESTER FOIL
C 2042	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 2043	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 2044	4822 124 20697	10UF	-10+50	25	ELECTROLYTIC
C 2046	4822 121 40522	100 NF	10	100	POLYESTER FOIL
C 2049	4822 122 30128	4,7NF	10	100	CERAMIC PLATE

RESISTORS

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1	5322 103 54027	5K	5	2W	MULTITURN W-W POTENTIOMETER
R 2	5322 102 44006	2x47k			CARBON TANDEM POTM + SWITCH
R 3	5322 101 44039	10k	20	0,1W	CARBON POTM LIN + SWITCH
R 4	5322 101 44039	10k	20	0,1W	CARBON POTM LIN + SWITCH
R 5	5322 101 44039	10k	20	0,1W	CARBON POTM LIN + SWITCH
R 6	5322 101 24129	4k7	20	0,1W	CARBON POTM LIN
R 7	5322 101 44039	10k	20	0,1W	CARBON POTM LIN + SWITCH
R 8	5322 101 34026	10K	20	0.1W	CARBON POTM LOG
R 9	5322 101 34026	10K	20	0.1W	CARBON POTM LOG
R 10	5322 101 44023	10K	20		CARBON POTM LIN + SWITCH
R 11	5322 101 44023	10K	20		CARBON POTM LIN + SWITCH
R 12	5322 101 24148	10K	20	0.1W	CARBON POTM LIN
R 13	5322 101 24148	10K	20	0.1W	CARBON POTM LIN
R 14	5322 101 44037	100K	20		CARBON POTM LIN + SWITCH
R 15	5322 101 24131	22K	20	0.1W	CARBON POTM LIN
R 16	5322 101 24132	10K	20	0.1W	CARBON POTM LIN
R 17	5322 101 24133	4,7M	20	0.1W	CARBON POTM LIN
R 18	5322 102 34019	2x47k	20	0,1W	CARBON TANDEM POTM
R 100	5322 116 50452	10	1	MR25	METAL FILM
R 101	5322 111 44121	1,8M	5	0,125W	CARBON
R 102	5322 116 64045	10	5	0.125W	METAL OXIDE
R 103	4822 116 51123	1K	5	0.125W	METAL FILM
R 104	5322 116 55152	900K	0,5	SPEC	METAL FILM
R 105	5322 116 64108	22	5	0.125W	METAL OXIDE
R 106	5322 116 55316	111K	0,5	MR25	METAL FILM
R 107	5322 116 64049	47	5	0.125W	METAL OXIDE
R 108	4822 116 51123	1K	5	0.125W	METAL FILM
R 109	5322 116 55153	992K	0,5	SPEC	METAL FILM
R 111	5322 116 55285	10,1K	0,5	MR25	METAL FILM
R 112	5322 116 64049	47	5	0.125W	METAL OXIDE
R 113	5322 116 64051	15	5	0.125W	METAL OXIDE
R 114	5322 111 30376	100M	5	0,125W	CARBON
R 116	5322 116 64051	15	5	0.125W	METAL OXIDE
R 117	5322 116 54442	51,1	1	MR25	METAL FILM
R 118	5322 116 54012	6,81K	1	MR25	METAL FILM
R 119	5322 116 50572	12,1K	1	MR25	METAL FILM
R 121	5322 116 54536	750	1	MR25	METAL FILM
R 122	5322 116 54335	750K	1	MR30	METAL FILM
R 123	5322 116 54735	255K	1	MR25	METAL FILM
R 124	5322 100 10143	1K	20	0.75W	TRIMMING POTM
R 126	5322 116 54038	221K	1	MR25	METAL FILM
R 127	4822 110 42214	10M	5	VR37	CARBON
R 128	4822 110 42227	33M	5	VR37	CARBON
R 129	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 131	5322 116 54595	5,11K	1	MR25	METAL FILM
R 132	5322 101 14056	47K	20	0.75W	TRIMMING POTM
R 133	5322 116 54696	100K	1	MR25	METAL FILM
R 134	5322 116 54743	301K	1	MR25	METAL FILM
R 141	5322 116 54504	274	1	MR25	METAL FILM
R 150	5322 116 50452	10	1	MR25	METAL FILM
R 151	5322 111 44121	1,8M	5	0,125W	CARBON
R 152	5322 116 64045	10	5	0.125W	METAL OXIDE
R 153	4822 116 51123	1K	5	0.125W	METAL FILM
R 154	5322 116 55152	900K	0,5	SPEC	METAL FILM
R 155	5322 116 64108	22	5	0.125W	METAL OXIDE
R 156	5322 116 55316	111K	0,5	MR25	METAL FILM
R 157	5322 116 64049	47	5	0.125W	METAL OXIDE
R 158	4822 116 51123	1K	5	0.125W	METAL FILM
R 159	5322 116 55153	992K	0,5	SPEC	METAL FILM
R 161	5322 116 55285	10,1K	0,5	MR25	METAL FILM
R 162	5322 116 64049	47	5	0.125W	METAL OXIDE
R 163	5322 116 64051	15	5	0.125W	METAL OXIDE
R 164	5322 111 30376	100M	5	0,125W	CARBON
R 166	5322 116 64051	15	5	0.125W	METAL OXIDE
R 167	5322 116 54442	51,1	1	MR25	METAL FILM
R 168	5322 116 54012	6,81K	1	MR25	METAL FILM
R 169	5322 116 50572	12,1K	1	MR25	METAL FILM
R 171	5322 116 54536	750	1	MR25	METAL FILM

R 172	5322 116 54335	750K	1	MR30	METAL FILM
R 173	5322 116 54735	255K	1	MR25	METAL FILM
R 174	5322 100 10143	1K	20	0.75W	TRIMMING POTM
R 176	5322 116 54038	221K	1	MR25	METAL FILM
R 177	4822 110 42214	10M	5	VR37	CARBON
R 178	4822 110 42227	33M	5	VR37	CARBON
R 179	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 181	5322 116 54595	5,11K	1	MR25	METAL FILM
R 182	5322 101 14056	47K	20	0.75W	TRIMMING POTM
R 183	5322 116 54696	100K	1	MR25	METAL FILM
R 184	5322 116 54743	301K	1	MR25	METAL FILM
R 191	5322 116 54504	274	1	MR25	METAL FILM
R 201	5322 116 50621	536	1	MR25	METAL FILM
R 202	5322 116 50904	30,1	1	MR25	METAL FILM
R 203	5322 116 50904	30,1	1	MR25	METAL FILM
R 206	5322 116 54442	51,1	1	MR25	METAL FILM
R 207	5322 116 64071	160	5	0.125W	METAL OXIDE
R 208	5322 116 54469	100	1	MR25	METAL FILM
R 209	5322 116 50583	5,9K	1	MR25	METAL FILM
R 211	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 212	5322 116 54619	10K	1	MR25	METAL FILM
R 213	5322 116 64071	160	5	0.125W	METAL OXIDE
R 214	5322 116 54469	100	1	MR25	METAL FILM
R 216	5322 116 50608	6,19K	1	MR25	METAL FILM
R 217	5322 116 50593	16,2K	1	MR25	METAL FILM
R 218	5322 116 54499	249	1	MR25	METAL FILM
R 219	5322 116 54469	100	1	MR25	METAL FILM
R 221	5322 116 54499	249	1	MR25	METAL FILM
R 222	5322 116 54469	100	1	MR25	METAL FILM
R 223	5322 116 54009	562	1	MR25	METAL FILM
R 224	5322 116 50608	6,19K	1	MR25	METAL FILM
R 226	5322 116 50593	16,2K	1	MR25	METAL FILM
R 227	5322 116 54511	316	1	MR25	METAL FILM
R 228	5322 116 50636	2,74K	1	MR25	METAL FILM
R 229	5322 116 54585	3,48K	1	MR25	METAL FILM
R 231	5322 116 54597	5,36K	1	MR25	METAL FILM
R 232	5322 116 54469	100	1	MR25	METAL FILM
R 233	5322 116 54446	56,2	1	MR25	METAL FILM
R 234	5322 116 54455	68,1	1	MR25	METAL FILM
R 236	5322 116 54497	226	1	MR25	METAL FILM
R 237	5322 116 54446	56,2	1	MR25	METAL FILM
R 238	5322 116 54455	68,1	1	MR25	METAL FILM
R 239	5322 116 54497	226	1	MR25	METAL FILM
R 241	5322 116 54696	100K	1	MR25	METAL FILM
R 242	5322 116 54696	100K	1	MR25	METAL FILM
R 243	5322 116 54585	3,48K	1	MR25	METAL FILM
R 244	5322 100 10138	100	20	0.75W	TRIMMING POTM
R 247	5322 116 50452	10	1	MR25	METAL FILM
R 248	5322 116 50678	20,5	1	MR25	METAL FILM
R 249	5322 116 54525	511	1	MR25	METAL FILM
R 251	5322 116 50678	20,5	1	MR25	METAL FILM
R 252	5322 116 50452	10	1	MR25	METAL FILM
R 253	5322 100 10144	2,2K	20	0.75W	TRIMMING POTM
R 254	5322 100 10139	4,7K	20	0.75W	TRIMMING POTM
R 256	5322 116 54549	1K	1	MR25	METAL FILM
R 257	5322 100 10139	4,7K	20	0.75W	TRIMMING POTM
R 258	5322 116 50583	5,9K	1	MR25	METAL FILM
R 259	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 261	5322 116 54469	100	1	MR25	METAL FILM
R 262	5322 116 50452	10	1	MR25	METAL FILM
R 263	5322 116 50452	10	1	MR25	METAL FILM
R 264	5322 116 54469	100	1	MR25	METAL FILM
R 266	5322 116 54469	100	1	MR25	METAL FILM
R 267	5322 116 54469	100	1	MR25	METAL FILM
R 268	5322 116 50484	4,64K	1	MR25	METAL FILM
R 269	5322 116 50484	4,64K	1	MR25	METAL FILM
R 271	5322 116 54549	1K	1	MR25	METAL FILM
R 272	5322 116 50593	16,2K	1	MR25	METAL FILM
R 273	5322 116 54484	140	1	MR25	METAL FILM
R 274	5322 116 54469	100	1	MR25	METAL FILM

R 276	5322 116 50621	536	1	MR25	METAL FILM
R 277	5322 116 54561	1,33K	1	MR25	METAL FILM
R 278	5322 116 54534	681	1	MR25	METAL FILM
R 279	5322 116 50452	10	1	MR25	METAL FILM
R 281	5322 116 50452	10	1	MR25	METAL FILM
R 282	5322 116 50452	10	1	MR25	METAL FILM
R 283	5322 116 54469	100	1	MR25	METAL FILM
R 284	5322 116 50484	4,64K	1	MR25	METAL FILM
R 286	5322 116 54595	5,11K	1	MR25	METAL FILM
R 287	5322 116 54595	5,11K	1	MR25	METAL FILM
R 288	5322 116 54469	100	1	MR25	METAL FILM
R 301	5322 116 50621	536	1	MR25	METAL FILM
R 302	5322 116 50904	30,1	1	MR25	METAL FILM
R 303	5322 116 50904	30,1	1	MR25	METAL FILM
R 306	5322 116 54442	51,1	1	MR25	METAL FILM
R 307	5322 116 64071	160	5	0.125W	METAL OXIDE
R 308	5322 116 54469	100	1	MR25	METAL FILM
R 309	5322 116 50583	5,9K	1	MR25	METAL FILM
R 311	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 312	5322 116 54619	10K	1	MR25	METAL FILM
R 313	5322 116 64071	160	5	0.125W	METAL OXIDE
R 314	5322 116 54469	100	1	MR25	METAL FILM
R 316	5322 116 50608	6,19K	1	MR25	METAL FILM
R 317	5322 116 50593	16,2K	1	MR25	METAL FILM
R 318	5322 116 54499	249	1	MR25	METAL FILM
R 319	5322 116 54469	100	1	MR25	METAL FILM
R 321	5322 116 54499	249	1	MR25	METAL FILM
R 322	5322 116 54469	100	1	MR25	METAL FILM
R 323	5322 116 54009	562	1	MR25	METAL FILM
R 324	5322 116 50608	6,19K	1	MR25	METAL FILM
R 326	5322 116 50593	16,2K	1	MR25	METAL FILM
R 327	5322 116 54511	316	1	MR25	METAL FILM
R 328	5322 116 50636	2,74K	1	MR25	METAL FILM
R 329	5322 116 54585	3,48K	1	MR25	METAL FILM
R 331	5322 116 54597	5,36K	1	MR25	METAL FILM
R 332	5322 116 54469	100	1	MR25	METAL FILM
R 333	5322 116 54446	56,2	1	MR25	METAL FILM
R 334	5322 116 54455	68,1	1	MR25	METAL FILM
R 336	5322 116 54497	226	1	MR25	METAL FILM
R 337	5322 116 54446	56,2	1	MR25	METAL FILM
R 338	5322 116 54455	68,1	1	MR25	METAL FILM
R 339	5322 116 54497	226	1	MR25	METAL FILM
R 341	5322 116 54696	100K	1	MR25	METAL FILM
R 342	5322 116 54696	100K	1	MR25	METAL FILM
R 343	5322 116 54585	3,48K	1	MR25	METAL FILM
R 344	5322 100 10138	100	20	0.75W	TRIMMING POTM
R 347	5322 116 50452	10	1	MR25	METAL FILM
R 348	5322 116 50678	20,5	1	MR25	METAL FILM
R 349	5322 116 54525	511	1	MR25	METAL FILM
R 351	5322 116 50678	20,5	1	MR25	METAL FILM
R 352	5322 116 50452	10	1	MR25	METAL FILM
R 353	5322 100 10144	2,2K	20	0.75W	TRIMMING POTM
R 354	5322 100 10139	4,7K	20	0.75W	TRIMMING POTM
R 356	5322 116 54549	1K	1	MR25	METAL FILM
R 357	5322 100 10139	4,7K	20	0.75W	TRIMMING POTM
R 358	5322 116 50583	5,9K	1	MR25	METAL FILM
R 359	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 361	5322 116 54469	100	1	MR25	METAL FILM
R 362	5322 116 50452	10	1	MR25	METAL FILM
R 363	5322 116 50452	10	1	MR25	METAL FILM
R 364	5322 116 54469	100	1	MR25	METAL FILM
R 366	5322 116 54469	100	1	MR25	METAL FILM
R 367	5322 116 54469	100	1	MR25	METAL FILM
R 368	5322 116 50484	4,64K	1	MR25	METAL FILM
R 369	5322 116 50484	4,64K	1	MR25	METAL FILM
R 371	5322 116 54549	1K	1	MR25	METAL FILM
R 372	5322 116 50593	16,2K	1	MR25	METAL FILM
R 373	5322 116 54534	681	1	MR25	METAL FILM
R 374	5322 116 54469	100	1	MR25	METAL FILM
R 376	5322 116 50621	536	1	MR25	METAL FILM

R 377	5322 116 54561	1,33K	1	MR25	METAL FILM
R 378	5322 116 54484	140	1	MR25	METAL FILM
R 379	5322 116 50452	10	1	MR25	METAL FILM
R 381	5322 116 50452	10	1	MR25	METAL FILM
R 382	5322 116 50452	10	1	MR25	METAL FILM
R 383	5322 116 54469	100	1	MR25	METAL FILM
R 384	5322 116 50484	4,64K	1	MR25	METAL FILM
R 386	5322 116 54595	5,11K	1	MR25	METAL FILM
R 387	5322 116 54595	5,11K	1	MR25	METAL FILM
R 388	5322 116 54469	100	1	MR25	METAL FILM
R 401	5322 116 54585	3,48K	1	MR25	METAL FILM
R 402	5322 116 54499	249	1	MR25	METAL FILM
R 403	5322 116 54585	3,48K	1	MR25	METAL FILM
R 404	5322 116 54469	100	1	MR25	METAL FILM
R 406	5322 116 50904	30,1	1	MR25	METAL FILM
R 407	5322 116 50904	30,1	1	MR25	METAL FILM
R 408	5322 116 50586	1,54K	1	MR25	METAL FILM
R 409	5322 100 10139	4,7K	20	0.75W	TRIMMING POTM
R 411	5322 100 10144	2,2K	20	0.75W	TRIMMING POTM
R 412	5322 116 50904	30,1	1	MR25	METAL FILM
R 413	5322 100 10133	220	20	0.75W	TRIMMING POTM
R 414	5322 116 50568	4,99	1	MR25	METAL FILM
R 416	5322 100 10138	100	20	0.75W	TRIMMING POTM
R 417	5322 116 50568	4,99	1	MR25	METAL FILM
R 418	5322 116 54516	365	1	MR25	METAL FILM
R 419	5322 116 54492	178	1	MR25	METAL FILM
R 421	5322 116 50452	10	1	MR25	METAL FILM
R 422	5322 116 50452	10	1	MR25	METAL FILM
R 423	5322 116 54442	51,1	1	MR25	METAL FILM
R 424	5322 116 54516	365	1	MR25	METAL FILM
R 426	5322 116 54696	100K	1	MR25	METAL FILM
R 427	5322 116 50583	5,9K	1	MR25	METAL FILM
R 428	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 429	5322 116 50583	5,9K	1	MR25	METAL FILM
R 431	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 432	5322 116 54696	100K	1	MR25	METAL FILM
R 433	5322 116 54469	100	1	MR25	METAL FILM
R 434	5322 116 54499	249	1	MR25	METAL FILM
R 436	5322 116 54558	8,25K	1	MR25	METAL FILM
R 437	5322 116 50671	2,61K	1	MR25	METAL FILM
R 438	5322 116 50664	2,05K	1	MR25	METAL FILM
R 439	5322 116 50572	12,1K	1	MR25	METAL FILM
R 441	5322 116 54619	10K	1	MR25	METAL FILM
R 442	5322 116 50671	2,61K	1	MR25	METAL FILM
R 443	5322 116 50479	15,4K	1	MR25	METAL FILM
R 451	5322 116 54585	3,48K	1	MR25	METAL FILM
R 452	5322 116 54499	249	1	MR25	METAL FILM
R 453	5322 116 54585	3,48K	1	MR25	METAL FILM
R 454	5322 116 54469	100	1	MR25	METAL FILM
R 456	5322 116 50904	30,1	1	MR25	METAL FILM
R 457	5322 116 50904	30,1	1	MR25	METAL FILM
R 458	5322 116 50586	1,54K	1	MR25	METAL FILM
R 459	5322 100 10139	4,7K	20	0.75W	TRIMMING POTM
R 461	5322 100 10144	2,2K	20	0.75W	TRIMMING POTM
R 462	5322 116 50904	30,1	1	MR25	METAL FILM
R 463	5322 100 10133	220	20	0.75W	TRIMMING POTM
R 464	5322 116 50568	4,99	1	MR25	METAL FILM
R 466	5322 100 10138	100	20	0.75W	TRIMMING POTM
R 467	5322 116 50568	4,99	1	MR25	METAL FILM
R 468	5322 116 54516	365	1	MR25	METAL FILM
R 469	5322 116 54492	178	1	MR25	METAL FILM
R 471	5322 116 50452	10	1	MR25	METAL FILM
R 472	5322 116 50452	10	1	MR25	METAL FILM
R 473	5322 116 54442	51,1	1	MR25	METAL FILM
R 474	5322 116 54516	365	1	MR25	METAL FILM
R 476	5322 116 54696	100K	1	MR25	METAL FILM
R 477	5322 116 50583	5,9K	1	MR25	METAL FILM
R 478	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 479	5322 116 50583	5,9K	1	MR25	METAL FILM
R 481	5322 100 10141	10K	20	0.75W	TRIMMING POTM

R 482	5322 116 54696	100K	1	MR25	METAL FILM
R 483	5322 116 54469	100	1	MR25	METAL FILM
R 484	5322 116 54499	249	1	MR25	METAL FILM
R 486	5322 116 54558	8,25K	1	MR25	METAL FILM
R 487	5322 116 50671	2,61K	1	MR25	METAL FILM
R 488	5322 116 50479	15,4K	1	MR25	METAL FILM
R 489	5322 116 54619	10K	1	MR25	METAL FILM
R 491	5322 116 54469	100	1	MR25	METAL FILM
R 493	5322 116 50671	2,61K	1	MR25	METAL FILM
R 494	5322 116 54469	100	1	MR25	METAL FILM
R 500	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 501	5322 116 54484	140	1	MR25	METAL FILM
R 502	5322 116 50766	147	1	MR25	METAL FILM
R 503	5322 116 50511	48,7	1	MR25	METAL FILM
R 504	5322 116 54504	274	1	MR25	METAL FILM
R 505	5322 116 50586	1,54K	1	MR25	METAL FILM
R 506	5322 116 54499	249	1	MR25	METAL FILM
R 507	5322 116 54484	140	1	MR25	METAL FILM
R 508	5322 116 54484	140	1	MR25	METAL FILM
R 509	5322 116 54519	402	1	MR25	METAL FILM
R 510	5322 116 50452	10	1	MR25	METAL FILM
R 511	5322 116 54442	51,1	1	MR25	METAL FILM
R 512	5322 116 50511	48,7	1	MR25	METAL FILM
R 513	5322 116 54504	274	1	MR25	METAL FILM
R 514	5322 116 54499	249	1	MR25	METAL FILM
R 515	5322 116 50452	10	1	MR25	METAL FILM
R 516	5322 116 54448	59	1	MR25	METAL FILM
R 517	5322 116 50524	3,01K	1	MR25	METAL FILM
R 518	5322 116 50636	2,74K	1	MR25	METAL FILM
R 519	5322 100 10138	100	20	0.75W	TRIMMING POTM
R 521	5322 116 50621	536	1	MR25	METAL FILM
R 522	5322 116 54504	274	1	MR25	METAL FILM
R 523	5322 116 50621	536	1	MR25	METAL FILM
R 524	5322 116 54448	59	1	MR25	METAL FILM
R 526	5322 116 50583	5,9K	1	MR25	METAL FILM
R 527	5322 100 10113	10K	0	0,5W	TRIMMING POTM
R 528	5322 116 54469	100	1	MR25	METAL FILM
R 529	5322 116 50621	536	1	MR25	METAL FILM
R 531	5322 116 50452	10	1	MR25	METAL FILM
R 534	5322 116 50904	30,1	1	MR25	METAL FILM
R 536	5322 116 54534	681	1	MR25	METAL FILM
R 537	5322 116 50904	30,1	1	MR25	METAL FILM
R 538	5322 116 50452	10	1	MR25	METAL FILM
R 539	5322 116 54549	1K	1	MR25	METAL FILM
R 541	5322 116 50452	10	1	MR25	METAL FILM
R 542	5322 116 50452	10	1	MR25	METAL FILM
R 543	5322 116 54469	100	1	MR25	METAL FILM
R 544	5322 116 50621	536	1	MR25	METAL FILM
R 546	5322 116 50484	4,64K	1	MR25	METAL FILM
R 547	5322 116 54469	100	1	MR25	METAL FILM
R 548	5322 116 50452	10	1	MR25	METAL FILM
R 552	5322 116 54426	121	1	MR25	METAL FILM
R 601	5322 116 50571	715	1	MR25	METAL FILM
R 602	5322 116 54442	51,1	1	MR25	METAL FILM
R 603	5322 116 50669	205	1	MR25	METAL FILM
R 604	5322 116 54448	59	1	MR25	METAL FILM
R 605	5322 116 54448	59	1	MR25	METAL FILM
R 606	5322 116 50729	4,22K	1	MR25	METAL FILM
R 607	5322 116 54469	100	1	MR25	METAL FILM
R 608	5322 116 50675	2,26K	1	MR25	METAL FILM
R 609	5322 116 54442	51,1	1	MR25	METAL FILM
R 611	5322 116 50571	715	1	MR25	METAL FILM
R 612	5322 116 50669	205	1	MR25	METAL FILM
R 613	5322 116 54448	59	1	MR25	METAL FILM
R 614	5322 116 54012	6,81K	1	MR25	METAL FILM
R 615	5322 116 54448	59	1	MR25	METAL FILM
R 616	5322 116 50484	4,64K	1	MR25	METAL FILM
R 617	5322 116 54515	348	1	MR25	METAL FILM
R 618	5322 116 54484	140	1	MR25	METAL FILM
R 619	5322 116 54558	8,25K	1	MR25	METAL FILM

R 621	5322 116 54469	100	1	MR25	METAL FILM
R 622	5322 116 54562	1,4K	1	MR25	METAL FILM
R 623	5322 116 54462	82,5	1	MR25	METAL FILM
R 624	5322 116 54484	140	1	MR25	METAL FILM
R 626	5322 116 54515	348	1	MR25	METAL FILM
R 627	5322 116 50484	4,64K	1	MR25	METAL FILM
R 628	5322 116 54012	6,81K	1	MR25	METAL FILM
R 629	5322 116 54549	1K	1	MR25	METAL FILM
R 631	5322 116 54511	316	1	MR25	METAL FILM
R 632	5322 116 50636	2,74K	1	MR25	METAL FILM
R 634	5322 101 14066	10K	20	0.5W	TRIMMING POTM
R 636	5322 101 14067	4,7K	20	0.5W	TRIMMING POTM
R 637	5322 116 54469	100	1	MR25	METAL FILM
R 638	5322 116 54469	100	1	MR25	METAL FILM
R 639	5322 116 50452	10	1	MR25	METAL FILM
R 640	5322 116 54619	10K	1	MR25	METAL FILM
R 641	5322 116 50452	10	1	MR25	METAL FILM
R 642	5322 116 54619	10K	1	MR25	METAL FILM
R 643	5322 116 50678	20,5	1	MR25	METAL FILM
R 644	5322 116 50678	20,5	1	MR25	METAL FILM
R 646	5322 101 14066	10K	20	0.5W	TRIMMING POTM
R 647	5322 116 50636	2,74K	1	MR25	METAL FILM
R 649	4822 116 30018	1,3K	10	1W	NTC
R 653	5322 116 54648	24,9K	1	MR25	METAL FILM
R 654	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 655	5322 116 50664	2,05K	1	MR25	METAL FILM
R 656	5322 116 50664	2,05K	1	MR25	METAL FILM
R 657	5322 116 54469	100	1	MR25	METAL FILM
R 658	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 659	5322 116 50766	147	1	MR25	METAL FILM
R 660	5322 116 50766	147	1	MR25	METAL FILM
R 661	5322 116 54469	100	1	MR25	METAL FILM
R 701	5322 116 54442	51,1	1	MR25	METAL FILM
R 702	5322 116 54408	909K	1	MR30	METAL FILM
R 703	5322 116 54701	110K	1	MR25	METAL FILM
R 704	5322 116 54508	301	1	MR25	METAL FILM
R 706	5322 116 54335	750K	1	MR30	METAL FILM
R 707	5322 116 54549	1K	1	MR25	METAL FILM
R 708	5322 116 54549	1K	1	MR25	METAL FILM
R 709	5322 116 54734	249K	1	MR25	METAL FILM
R 711	4822 110 63214	10M	10	CR25	CARBON
R 712	5322 116 50527	33,2	1	MR25	METAL FILM
R 713	5322 116 54012	6,81K	1	MR25	METAL FILM
R 714	5322 116 54648	24,9K	1	MR25	METAL FILM
R 716	5322 116 50572	12,1K	1	MR25	METAL FILM
R 717	5322 116 54696	100K	1	MR25	METAL FILM
R 718	5322 116 54648	24,9K	1	MR25	METAL FILM
R 719	5322 116 54012	6,81K	1	MR25	METAL FILM
R 721	5322 116 50572	12,1K	1	MR25	METAL FILM
R 722	5322 116 54648	24,9K	1	MR25	METAL FILM
R 723	5322 116 54012	6,81K	1	MR25	METAL FILM
R 724	5322 116 54547	953	1	MR25	METAL FILM
R 726	5322 116 54469	100	1	MR25	METAL FILM
R 727	5322 116 54557	1,21K	1	MR25	METAL FILM
R 728	5322 116 54595	5,11K	1	MR25	METAL FILM
R 729	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 730	5322 116 54525	511	1	MR25	METAL FILM
R 731	5322 116 54723	187K	1	MR25	METAL FILM
R 732	5322 116 54605	6,98K	1	MR25	METAL FILM
R 733	5322 116 50581	2,49K	1	MR25	METAL FILM
R 734	5322 116 54685	71,5K	1	MR25	METAL FILM
R 735	5322 116 54595	5,11K	1	MR25	METAL FILM
R 736	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 738	5322 116 54496	200	1	MR25	METAL FILM
R 741	5322 116 54529	619	1	MR25	METAL FILM
R 742	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 744	5322 116 50452	10	1	MR25	METAL FILM
R 801	5322 116 54469	100	1	MR25	METAL FILM
R 802	5322 116 54536	750	1	MR25	METAL FILM
R 803	5322 116 50556	4,42K	1	MR25	METAL FILM

R 804	5322 116 54541	825	1	MR25	METAL FILM
R 805	5322 116 54469	100	1	MR25	METAL FILM
R 806	5322 116 54525	511	1	MR25	METAL FILM
R 807	5322 116 54536	750	1	MR25	METAL FILM
R 808	5322 116 54469	100	1	MR25	METAL FILM
R 809	5322 116 50492	46,4	1	MR25	METAL FILM
R 811	5322 116 50527	33,2	1	MR25	METAL FILM
R 812	5322 116 54585	3,48K	1	MR25	METAL FILM
R 813	5322 116 54558	8,25K	1	MR25	METAL FILM
R 814	5322 116 50527	33,2	1	MR25	METAL FILM
R 816	5322 116 54511	316	1	MR25	METAL FILM
R 817	5322 116 54442	51,1	1	MR25	METAL FILM
R 818	5322 116 54442	51,1	1	MR25	METAL FILM
R 819	5322 116 50635	1,47K	1	MR25	METAL FILM
R 820	5322 116 54525	511	1	MR25	METAL FILM
R 821	5322 116 50635	1,47K	1	MR25	METAL FILM
R 822	5322 116 50558	18,7K	1	MR25	METAL FILM
R 823	5322 116 50558	18,7K	1	MR25	METAL FILM
R 824	5322 116 54469	100	1	MR25	METAL FILM
R 825	5322 116 54525	511	1	MR25	METAL FILM
R 826	5322 116 50635	1,47K	1	MR25	METAL FILM
R 827	5322 116 50635	1,47K	1	MR25	METAL FILM
R 828	5322 116 50558	18,7K	1	MR25	METAL FILM
R 829	5322 116 50558	18,7K	1	MR25	METAL FILM
R 830	5322 116 54469	100	1	MR25	METAL FILM
R 831	5322 116 54469	100	1	MR25	METAL FILM
R 832	5322 116 50635	1,47K	1	MR25	METAL FILM
R 833	5322 116 50635	1,47K	1	MR25	METAL FILM
R 834	5322 116 50558	18,7K	1	MR25	METAL FILM
R 835	5322 116 50536	464	1	MR25	METAL FILM
R 836	5322 116 50558	18,7K	1	MR25	METAL FILM
R 837	5322 116 54442	51,1	1	MR25	METAL FILM
R 838	5322 116 54442	51,1	1	MR25	METAL FILM
R 839	5322 116 54541	825	1	MR25	METAL FILM
R 841	5322 116 50459	422	1	MR25	METAL FILM
R 842	5322 100 10135	470	20	0.75W	TRIMMING POTM
R 844	5322 116 50527	33,2	1	MR25	METAL FILM
R 845	5322 100 10133	220	20	0.75W	TRIMMING POTM
R 846	5322 116 54516	365	1	MR25	METAL FILM
R 847	5322 116 54516	365	1	MR25	METAL FILM
R 848	5322 116 54545	909	1	MR25	METAL FILM
R 849	5322 116 50766	147	1	MR25	METAL FILM
R 851	5322 116 54545	909	1	MR25	METAL FILM
R 852	5322 116 50491	22,6	1	MR25	METAL FILM
R 853	5322 116 54469	100	1	MR25	METAL FILM
R 854	5322 116 50569	95,3	1	MR25	METAL FILM
R 855	5322 116 54469	100	1	MR25	METAL FILM
R 856	5322 116 54536	750	1	MR25	METAL FILM
R 857	5322 116 50569	95,3	1	MR25	METAL FILM
R 858	5322 116 50527	33,2	1	MR25	METAL FILM
R 859	5322 116 54541	825	1	MR25	METAL FILM
R 861	5322 116 50527	33,2	1	MR25	METAL FILM
R 863	5322 116 54502	261	1	MR25	METAL FILM
R 864	5322 116 54426	121	1	MR25	METAL FILM
R 865	5322 116 54192	5,11	1	MR25	METAL FILM
R 866	5322 116 54426	121	1	MR25	METAL FILM
R 867	5322 116 50527	33,2	1	MR25	METAL FILM
R 868	5322 116 54511	316	1	MR25	METAL FILM
R 869	5322 116 54513	332	1	MR25	METAL FILM
R 870	5322 116 54469	100	1	MR25	METAL FILM
R 871	5322 116 54466	90,9	1	MR25	METAL FILM
R 872	5322 116 50491	22,6	1	MR25	METAL FILM
R 873	5322 116 50593	16,2K	1	MR25	METAL FILM
R 874	5322 116 54469	100	1	MR25	METAL FILM
R 875	5322 116 50491	22,6	1	MR25	METAL FILM
R 876	5322 116 50491	22,6	1	MR25	METAL FILM
R 877	5322 116 50586	1,54K	1	MR25	METAL FILM
R 878	5322 116 54534	681	1	MR25	METAL FILM
R 879	5322 116 50586	1,54K	1	MR25	METAL FILM
R 881	5322 100 10141	10K	20	0.75W	TRIMMING POTM

R 882	5322 116 54486	150	1	MR25	METAL FILM
R 883	5322 116 54511	316	1	MR25	METAL FILM
R 884	5322 116 54513	332	1	MR25	METAL FILM
R 885	5322 116 54442	51,1	1	MR25	METAL FILM
R 886	5322 116 54466	90,9	1	MR25	METAL FILM
R 887	5322 116 50491	22,6	1	MR25	METAL FILM
R 888	5322 116 50593	16,2K	1	MR25	METAL FILM
R 889	5322 116 54469	100	1	MR25	METAL FILM
R 890	5322 116 54192	5,11	1	MR25	METAL FILM
R 891	5322 116 50491	22,6	1	MR25	METAL FILM
R 892	5322 116 50491	22,6	1	MR25	METAL FILM
R 893	5322 116 54511	316	1	MR25	METAL FILM
R 894	5322 116 54442	51,1	1	MR25	METAL FILM
R 895	5322 116 50506	154	1	MR25	METAL FILM
R 896	5322 116 54504	274	1	MR25	METAL FILM
R 897	5322 116 54511	316	1	MR25	METAL FILM
R 898	5322 116 54549	1K	1	MR25	METAL FILM
R 899	5322 116 54619	10K	1	MR25	METAL FILM
R 900	5322 116 54567	1,69K	1	MR25	METAL FILM
R 901	5322 116 50664	2,05K	1	MR25	METAL FILM
R 902	5322 116 54549	1K	1	MR25	METAL FILM
R 903	5322 116 54541	825	1	MR25	METAL FILM
R 904	5322 116 50527	33,2	1	MR25	METAL FILM
R 905	5322 116 54508	301	1	MR25	METAL FILM
R 906	5322 116 50536	464	1	MR25	METAL FILM
R 907	5322 116 50536	464	1	MR25	METAL FILM
R 908	5322 116 50675	2,26K	1	MR25	METAL FILM
R 909	5322 116 50675	2,26K	1	MR25	METAL FILM
R 910	5322 116 54606	7,15K	1	MR25	METAL FILM
R 911	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 912	5322 116 54595	5,11K	1	MR25	METAL FILM
R 913	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 914	5322 116 54536	750	1	MR25	METAL FILM
R 916	5322 116 50581	2,49K	1	MR25	METAL FILM
R 917	5322 116 54619	10K	1	MR25	METAL FILM
R 918	5322 116 54589	3,83K	1	MR25	METAL FILM
R 919	5322 116 50527	33,2	1	MR25	METAL FILM
R 920	5322 116 54508	301	1	MR25	METAL FILM
R 921	5322 116 50572	12,1K	1	MR25	METAL FILM
R 922	5322 116 50583	5,9K	1	MR25	METAL FILM
R 923	5322 116 50527	33,2	1	MR25	METAL FILM
R 924	5322 116 50527	33,2	1	MR25	METAL FILM
R 926	5322 116 54249	487	0,25	MR24C	METAL FILM
R 927	5322 116 50481	22,6K	1	MR25	METAL FILM
R 928	5322 116 54549	1K	1	MR25	METAL FILM
R 929	5322 116 50481	22,6K	1	MR25	METAL FILM
R 931	5322 116 54549	1K	1	MR25	METAL FILM
R 932	5322 116 50481	22,6K	1	MR25	METAL FILM
R 933	5322 116 54549	1K	1	MR25	METAL FILM
R 934	5322 116 50954	38,3	1	MR25	METAL FILM
R 936	5322 116 54619	10K	1	MR25	METAL FILM
R 937	5322 116 54619	10K	1	MR25	METAL FILM
R 938	4822 110 63207	5,6M	10	CR25	CARBON
R 939	5322 116 54619	10K	1	MR25	METAL FILM
R 940	5322 116 54513	332	1	MR25	METAL FILM
R 941	5322 116 54192	5,11	1	MR25	METAL FILM
R 942	5322 116 50664	2,05K	1	MR25	METAL FILM
R 943	5322 116 54455	68,1	1	MR25	METAL FILM
R 944	5322 116 50482	33,2K	1	MR25	METAL FILM
R 945	5322 116 50527	33,2	1	MR25	METAL FILM
R 946	5322 116 50581	2,49K	1	MR25	METAL FILM
R 947	5322 116 50664	2,05K	1	MR25	METAL FILM
R 948	5322 116 50728	1,87K	1	MR25	METAL FILM
R 949	5322 116 54466	90,9	1	MR25	METAL FILM
R 950	5322 116 54525	511	1	MR25	METAL FILM
R 951	5322 116 54442	51,1	1	MR25	METAL FILM
R 952	5322 116 54504	274	1	MR25	METAL FILM
R 953	5322 116 54469	100	1	MR25	METAL FILM
R 954	5322 116 54504	274	1	MR25	METAL FILM
R 955	5322 116 54442	51,1	1	MR25	METAL FILM

R 956	5322 116 54536	750	1	MR25	METAL FILM
R 957	5322 116 50491	22,6	1	MR25	METAL FILM
R 958	5322 116 54536	750	1	MR25	METAL FILM
R 959	5322 116 54005	3,32K	1	MR25	METAL FILM
R 960	5322 116 54558	8,25K	1	MR25	METAL FILM
R 961	5322 116 54619	10K	1	MR25	METAL FILM
R 962	5322 116 54549	1K	1	MR25	METAL FILM
R 963	5322 116 50669	205	1	MR25	METAL FILM
R 964	5322 116 50481	22,6K	1	MR25	METAL FILM
R 965	5322 116 50482	33,2K	1	MR25	METAL FILM
R 966	5322 116 54009	562	1	MR25	METAL FILM
R 967	5322 116 54504	274	1	MR25	METAL FILM
R 968	5322 116 54504	274	1	MR25	METAL FILM
R 969	5322 116 54469	100	1	MR25	METAL FILM
R 970	5322 116 54619	10K	1	MR25	METAL FILM
R 971	5322 116 50635	1,47K	1	MR25	METAL FILM
R 972	5322 116 54619	10K	1	MR25	METAL FILM
R 973	5322 116 50536	464	1	MR25	METAL FILM
R 974	5322 116 50593	16,2K	1	MR25	METAL FILM
R 975	5322 116 54469	100	1	MR25	METAL FILM
R 976	5322 116 50482	33,2K	1	MR25	METAL FILM
R 977	5322 116 50479	15,4K	1	MR25	METAL FILM
R 978	5322 116 50635	1,47K	1	MR25	METAL FILM
R 979	5322 116 54549	1K	1	MR25	METAL FILM
R 980	5322 116 54589	3,83K	1	MR25	METAL FILM
R 981	5322 116 54549	1K	1	MR25	METAL FILM
R 982	5322 116 54549	1K	1	MR25	METAL FILM
R 983	5322 116 50481	22,6K	1	MR25	METAL FILM
R 984	5322 116 54519	402	1	MR25	METAL FILM
R 985	5322 116 55315	619K	1	MR25	METAL FILM
R 986	5322 116 50527	33,2	1	MR25	METAL FILM
R 987	5322 116 50482	33,2K	1	MR25	METAL FILM
R 992	5322 116 50555	1,27K	1	MR25	METAL FILM
R 993	5322 116 54549	1K	1	MR25	METAL FILM
R 994	5322 116 50767	2,15K	1	MR25	METAL FILM
R 995	5322 116 54508	301	1	MR25	METAL FILM
R 996	5322 116 54508	301	1	MR25	METAL FILM
R 997	5322 116 54442	51,1	1	MR25	METAL FILM
R 998	5322 116 54619	10K	1	MR25	METAL FILM
R 1001	5322 116 54877	402	0,25	MR24C	METAL FILM
R 1002	5322 116 54902	876K	0,25	MR54C	METAL FILM
R 1003	5322 116 54901	887K	0,25	MR54C	METAL FILM
R 1004	5322 116 54896	354K	0,25	MR34C	METAL FILM
R 1006	5322 116 54899	176K	0,25	MR34C	METAL FILM
R 1007	5322 116 54897	87,6K	0,25	MR24C	METAL FILM
R 1008	5322 116 54895	34,6K	0,25	MR24C	METAL FILM
R 1009	5322 116 54894	16,8K	0,25	MR24C	METAL FILM
R 1011	5322 116 55161	7,96K	0,25	MR24C	METAL FILM
R 1012	5322 116 50784	2,67K	0,25	MR24C	METAL FILM
R 1013	5322 116 54898	887	0,25	MR24C	METAL FILM
R 1014	5322 116 54504	274	1	MR25	METAL FILM
R 1101	5322 116 50527	33,2	1	MR25	METAL FILM
R 1102	5322 116 54335	750K	1	MR30	METAL FILM
R 1103	5322 116 54549	1K	1	MR25	METAL FILM
R 1104	5322 116 54549	1K	1	MR25	METAL FILM
R 1106	5322 116 54734	249K	1	MR25	METAL FILM
R 1107	4822 110 63214	10M	10	CR25	CARBON
R 1108	5322 116 50581	2,49K	1	MR25	METAL FILM
R 1109	5322 116 50527	33,2	1	MR25	METAL FILM
R 1111	5322 116 54012	6,81K	1	MR25	METAL FILM
R 1112	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1113	5322 116 54552	1,05K	1	MR25	METAL FILM
R 1114	5322 116 54723	187K	1	MR25	METAL FILM
R 1116	5322 116 54558	8,25K	1	MR25	METAL FILM
R 1117	5322 116 54685	71,5K	1	MR25	METAL FILM
R 1118	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1201	5322 116 54585	3,48K	1	MR25	METAL FILM
R 1202	5322 116 54558	8,25K	1	MR25	METAL FILM
R 1203	5322 116 54511	316	1	MR25	METAL FILM
R 1204	5322 116 50527	33,2	1	MR25	METAL FILM

R 1206	5322 116 50527	33,2	1	MR25	METAL FILM
R 1207	5322 116 50492	46,4	1	MR25	METAL FILM
R 1208	5322 116 54469	100	1	MR25	METAL FILM
R 1209	5322 116 54469	100	1	MR25	METAL FILM
R 1211	5322 116 54469	100	1	MR25	METAL FILM
R 1212	5322 116 54525	511	1	MR25	METAL FILM
R 1213	5322 116 54536	750	1	MR25	METAL FILM
R 1214	5322 116 54536	750	1	MR25	METAL FILM
R 1216	5322 116 54525	511	1	MR25	METAL FILM
R 1217	5322 116 54525	511	1	MR25	METAL FILM
R 1218	5322 116 54442	51,1	1	MR25	METAL FILM
R 1219	5322 116 54442	51,1	1	MR25	METAL FILM
R 1221	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1222	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1223	5322 116 50558	18,7K	1	MR25	METAL FILM
R 1224	5322 116 50558	18,7K	1	MR25	METAL FILM
R 1226	5322 116 54469	100	1	MR25	METAL FILM
R 1227	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1228	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1229	5322 116 50558	18,7K	1	MR25	METAL FILM
R 1231	5322 116 50558	18,7K	1	MR25	METAL FILM
R 1232	5322 116 54469	100	1	MR25	METAL FILM
R 1233	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1234	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1236	5322 116 50558	18,7K	1	MR25	METAL FILM
R 1237	5322 116 50558	18,7K	1	MR25	METAL FILM
R 1238	5322 116 54534	681	1	MR25	METAL FILM
R 1239	5322 116 54469	100	1	MR25	METAL FILM
R 1241	5322 116 50491	22,6	1	MR25	METAL FILM
R 1242	5322 116 54469	100	1	MR25	METAL FILM
R 1243	5322 116 54536	750	1	MR25	METAL FILM
R 1244	5322 116 54448	59	1	MR25	METAL FILM
R 1246	5322 116 50527	33,2	1	MR25	METAL FILM
R 1248	5322 116 54541	825	1	MR25	METAL FILM
R 1249	5322 116 50527	33,2	1	MR25	METAL FILM
R 1251	5322 116 54502	261	1	MR25	METAL FILM
R 1252	5322 116 54426	121	1	MR25	METAL FILM
R 1253	5322 116 54426	121	1	MR25	METAL FILM
R 1254	5322 116 50527	33,2	1	MR25	METAL FILM
R 1256	5322 116 54511	316	1	MR25	METAL FILM
R 1257	5322 116 54513	332	1	MR25	METAL FILM
R 1258	5322 116 54466	90,9	1	MR25	METAL FILM
R 1259	5322 116 50491	22,6	1	MR25	METAL FILM
R 1261	5322 116 54469	100	1	MR25	METAL FILM
R 1262	5322 116 54532	649	1	MR25	METAL FILM
R 1263	5322 116 54532	649	1	MR25	METAL FILM
R 1264	5322 116 54511	316	1	MR25	METAL FILM
R 1266	5322 116 54513	332	1	MR25	METAL FILM
R 1267	5322 116 54466	90,9	1	MR25	METAL FILM
R 1268	5322 116 50491	22,6	1	MR25	METAL FILM
R 1269	5322 116 54469	100	1	MR25	METAL FILM
R 1271	5322 116 50593	16,2K	1	MR25	METAL FILM
R 1272	5322 116 54511	316	1	MR25	METAL FILM
R 1273	5322 116 54469	100	1	MR25	METAL FILM
R 1274	5322 116 50491	22,6	1	MR25	METAL FILM
R 1276	5322 116 50491	22,6	1	MR25	METAL FILM
R 1277	5322 116 54486	150	1	MR25	METAL FILM
R 1278	5322 116 54442	51,1	1	MR25	METAL FILM
R 1279	5322 116 50506	154	1	MR25	METAL FILM
R 1281	5322 116 54504	274	1	MR25	METAL FILM
R 1282	5322 116 50491	22,6	1	MR25	METAL FILM
R 1283	5322 116 54469	100	1	MR25	METAL FILM
R 1284	5322 116 50491	22,6	1	MR25	METAL FILM
R 1286	5322 116 54469	100	1	MR25	METAL FILM
R 1287	5322 116 50593	16,2K	1	MR25	METAL FILM
R 1288	5322 116 54511	316	1	MR25	METAL FILM
R 1289	5322 116 54549	1K	1	MR25	METAL FILM
R 1291	5322 116 54619	10K	1	MR25	METAL FILM
R 1292	5322 116 54442	51,1	1	MR25	METAL FILM
R 1293	5322 116 54525	511	1	MR25	METAL FILM

R 1300	5322 116 54562	1,4K	1	MR25	METAL FILM
R 1301	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1303	5322 116 54536	750	1	MR25	METAL FILM
R 1304	5322 116 50556	4,42K	1	MR25	METAL FILM
R 1305	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1306	5322 116 54504	274	1	MR25	METAL FILM
R 1307	5322 116 54504	274	1	MR25	METAL FILM
R 1308	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1309	5322 116 50536	464	1	MR25	METAL FILM
R 1310	5322 116 54619	10K	1	MR25	METAL FILM
R 1311	5322 116 54469	100	1	MR25	METAL FILM
R 1312	5322 116 50536	464	1	MR25	METAL FILM
R 1313	5322 116 54549	1K	1	MR25	METAL FILM
R 1314	5322 116 50527	33,2	1	MR25	METAL FILM
R 1317	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1318	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 1319	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1320	5322 116 54619	10K	1	MR25	METAL FILM
R 1321	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 1322	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1323	5322 116 54536	750	1	MR25	METAL FILM
R 1324	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1326	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 1327	5322 116 54589	3,83K	1	MR25	METAL FILM
R 1328	5322 116 54619	10K	1	MR25	METAL FILM
R 1329	5322 116 50527	33,2	1	MR25	METAL FILM
R 1331	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1332	5322 116 50583	5,9K	1	MR25	METAL FILM
R 1333	5322 116 50527	33,2	1	MR25	METAL FILM
R 1334	5322 116 50527	33,2	1	MR25	METAL FILM
R 1335	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1336	5322 116 54898	887	0,25	MR24C	METAL FILM
R 1337	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1338	5322 116 54549	1K	1	MR25	METAL FILM
R 1339	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1341	5322 116 54549	1K	1	MR25	METAL FILM
R 1342	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1343	5322 116 54549	1K	1	MR25	METAL FILM
R 1344	5322 116 50954	38,3	1	MR25	METAL FILM
R 1346	5322 116 54619	10K	1	MR25	METAL FILM
R 1347	5322 116 54455	68,1	1	MR25	METAL FILM
R 1348	5322 116 50482	33,2K	1	MR25	METAL FILM
R 1349	5322 116 50581	2,49K	1	MR25	METAL FILM
R 1350	5322 116 54513	332	1	MR25	METAL FILM
R 1351	4822 110 63207	5,6M	10	CR25	CARBON
R 1352	5322 116 54192	5,11	1	MR25	METAL FILM
R 1353	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1354	5322 116 54619	10K	1	MR25	METAL FILM
R 1355	5322 116 50527	33,2	1	MR25	METAL FILM
R 1356	5322 116 54619	10K	1	MR25	METAL FILM
R 1357	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1358	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1359	5322 116 54504	274	1	MR25	METAL FILM
R 1360	5322 116 50555	1,27K	1	MR25	METAL FILM
R 1361	5322 116 54504	274	1	MR25	METAL FILM
R 1362	5322 116 54536	750	1	MR25	METAL FILM
R 1363	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1364	5322 116 54469	100	1	MR25	METAL FILM
R 1365	5322 116 54549	1K	1	MR25	METAL FILM
R 1366	5322 116 54561	1,33K	1	MR25	METAL FILM
R 1367	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1368	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1369	5322 116 50415	1,15K	1	MR25	METAL FILM
R 1370	5322 116 54549	1K	1	MR25	METAL FILM
R 1371	5322 116 54469	100	1	MR25	METAL FILM
R 1372	5322 116 54469	100	1	MR25	METAL FILM
R 1373	5322 116 50527	33,2	1	MR25	METAL FILM
R 1374	5322 116 50527	33,2	1	MR25	METAL FILM
R 1376	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1377	5322 116 54005	3,32K	1	MR25	METAL FILM

R 1378	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1379	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1381	5322 116 50527	33,2	1	MR25	METAL FILM
R 1382	5322 116 54011	5,62K	1	MR25	METAL FILM
R 1383	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1384	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1386	5322 116 54508	301	1	MR25	METAL FILM
R 1387	5322 116 50561	590	1	MR25	METAL FILM
R 1388	5322 116 54508	301	1	MR25	METAL FILM
R 1389	5322 116 54545	909	1	MR25	METAL FILM
R 1391	5322 116 54545	909	1	MR25	METAL FILM
R 1392	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1393	5322 116 54536	750	1	MR25	METAL FILM
R 1394	5322 116 54549	1K	1	MR25	METAL FILM
R 1396	5322 116 54508	301	1	MR25	METAL FILM
R 1397	5322 116 54508	301	1	MR25	METAL FILM
R 1398	5322 116 50767	2,15K	1	MR25	METAL FILM
R 1401	5322 116 54901	887K	0,25	MR54C	METAL FILM
R 1402	5322 116 54896	354K	0,25	MR34C	METAL FILM
R 1403	5322 116 54899	176K	0,25	MR34C	METAL FILM
R 1404	5322 116 54897	87,6K	0,25	MR24C	METAL FILM
R 1406	5322 116 54895	34,6K	0,25	MR24C	METAL FILM
R 1407	5322 116 54894	16,8K	0,25	MR24C	METAL FILM
R 1408	5322 116 55161	7,96K	0,25	MR24C	METAL FILM
R 1409	5322 116 50784	2,67K	0,25	MR24C	METAL FILM
R 1411	5322 116 54898	887	0,25	MR24C	METAL FILM
R 1501	5322 116 54549	1K	1	MR25	METAL FILM
R 1502	5322 116 54619	10K	1	MR25	METAL FILM
R 1503	5322 116 50527	33,2	1	MR25	METAL FILM
R 1504	5322 116 50482	33,2K	1	MR25	METAL FILM
R 1506	5322 116 54619	10K	1	MR25	METAL FILM
R 1507	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1508	5322 116 54519	402	1	MR25	METAL FILM
R 1509	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1511	5322 116 54519	402	1	MR25	METAL FILM
R 1512	5322 116 54549	1K	1	MR25	METAL FILM
R 1513	5322 116 54549	1K	1	MR25	METAL FILM
R 1514	5322 116 54619	10K	1	MR25	METAL FILM
R 1515	5322 116 50536	464	1	MR25	METAL FILM
R 1516	5322 116 54619	10K	1	MR25	METAL FILM
R 1517	5322 116 50527	33,2	1	MR25	METAL FILM
R 1518	5322 116 50482	33,2K	1	MR25	METAL FILM
R 1519	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1520	5322 116 54012	6,81K	1	MR25	METAL FILM
R 1521	5322 116 54592	4,02K	1	MR25	METAL FILM
R 1522	5322 116 50482	33,2K	1	MR25	METAL FILM
R 1524	5322 116 50458	7,87K	1	MR25	METAL FILM
R 1525	5322 116 50492	46,4	1	MR25	METAL FILM
R 1526	5322 116 50728	1,87K	1	MR25	METAL FILM
R 1527	5322 116 50527	33,2	1	MR25	METAL FILM
R 1528	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1529	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1531	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1532	5322 116 50482	33,2K	1	MR25	METAL FILM
R 1533	5322 116 54619	10K	1	MR25	METAL FILM
R 1534	5322 116 54629	14K	1	MR25	METAL FILM
R 1535	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1536	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1537	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 1538	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1539	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1541	5322 116 54469	100	1	MR25	METAL FILM
R 1542	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1543	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1551	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1552	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1553	5322 116 54585	3,48K	1	MR25	METAL FILM
R 1554	5322 116 54513	332	1	MR25	METAL FILM
R 1556	5322 116 54683	68,1K	1	MR25	METAL FILM
R 1557	5322 116 54513	332	1	MR25	METAL FILM

R 1558	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1559	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1561	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1562	5322 116 54513	332	1	MR25	METAL FILM
R 1563	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1564	5322 116 51052	42,2	1	MR25	METAL FILM
R 1566	5322 116 54513	332	1	MR25	METAL FILM
R 1567	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1568	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1569	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1570	5322 116 54469	100	1	MR25	METAL FILM
R 1571	5322 116 54513	332	1	MR25	METAL FILM
R 1572	5322 116 54683	68,1K	1	MR25	METAL FILM
R 1573	5322 116 54484	140	1	MR25	METAL FILM
R 1574	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1576	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1577	5322 116 54513	332	1	MR25	METAL FILM
R 1578	5322 116 51052	42,2	1	MR25	METAL FILM
R 1579	5322 116 54562	1,4K	1	MR25	METAL FILM
R 1581	5322 116 54513	332	1	MR25	METAL FILM
R 1601	5322 116 54534	681	1	MR25	METAL FILM
R 1602	5322 116 54592	4,02K	1	MR25	METAL FILM
R 1603	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1604	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1606	5322 116 54592	4,02K	1	MR25	METAL FILM
R 1607	5322 116 54549	1K	1	MR25	METAL FILM
R 1608	5322 116 54637	17,8K	1	MR25	METAL FILM
R 1609	5322 116 50586	1,54K	1	MR25	METAL FILM
R 1611	5322 116 50586	1,54K	1	MR25	METAL FILM
R 1612	5322 116 54549	1K	1	MR25	METAL FILM
R 1613	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1614	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1615	5322 116 54549	1K	1	MR25	METAL FILM
R 1616	5322 116 54513	332	1	MR25	METAL FILM
R 1617	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1618	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1619	5322 116 54549	1K	1	MR25	METAL FILM
R 1621	5322 116 54549	1K	1	MR25	METAL FILM
R 1622	5322 116 54469	100	1	MR25	METAL FILM
R 1627	5322 116 54469	100	1	MR25	METAL FILM
R 1628	5322 116 54469	100	1	MR25	METAL FILM
R 1629	5322 116 54469	100	1	MR25	METAL FILM
R 1630	5322 116 50452	10	1	MR25	METAL FILM
R 1631	5322 116 54469	100	1	MR25	METAL FILM
R 1632	5322 116 54469	100	1	MR25	METAL FILM
R 1633	5322 116 54469	100	1	MR25	METAL FILM
R 1651	5322 116 54538	787	1	MR25	METAL FILM
R 1652	5322 116 50515	1,78K	1	MR25	METAL FILM
R 1653	5322 116 54632	14,7K	1	MR25	METAL FILM
R 1654	5322 100 10139	4,7K	20	0.75W	TRIMMING POTM
R 1659	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1661	5322 116 50671	2,61K	1	MR25	METAL FILM
R 1664	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1666	5322 116 54549	1K	1	MR25	METAL FILM
R 1667	5322 116 50527	33,2	1	MR25	METAL FILM
R 1668	5322 116 50527	33,2	1	MR25	METAL FILM
R 1669	5322 116 54538	787	1	MR25	METAL FILM
R 1671	5322 116 50515	1,78K	1	MR25	METAL FILM
R 1672	5322 116 54632	14,7K	1	MR25	METAL FILM
R 1673	5322 100 10139	4,7K	20	0.75W	TRIMMING POTM
R 1678	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1679	5322 116 50527	33,2	1	MR25	METAL FILM
R 1681	5322 116 50527	33,2	1	MR25	METAL FILM
R 1682	5322 116 50671	2,61K	1	MR25	METAL FILM
R 1686	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1687	5322 116 54549	1K	1	MR25	METAL FILM
R 1701	5322 116 54525	511	1	MR25	METAL FILM
R 1702	5322 116 50561	590	1	MR25	METAL FILM
R 1703	5322 116 50527	33,2	1	MR25	METAL FILM
R 1704	5322 116 50417	162	1	MR25	METAL FILM

R 1706	5322 100 10143	1K	20	0.75W	TRIMMING POTM
R 1707	5322 116 54474	110	1	MR25	METAL FILM
R 1708	5322 116 50581	2,49K	1	MR25	METAL FILM
R 1709	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 1710	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1711	5322 116 50732	549	1	MR25	METAL FILM
R 1712	5322 116 50732	549	1	MR25	METAL FILM
R 1713	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1714	5322 116 54619	10K	1	MR25	METAL FILM
R 1716	5322 116 50592	442	1	MR25	METAL FILM
R 1718	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1719	5322 116 50491	22,6	1	MR25	METAL FILM
R 1721	5322 116 50527	33,2	1	MR25	METAL FILM
R 1722	5322 116 54701	110K	1	MR25	METAL FILM
R 1723	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1724	5322 116 54696	100K	1	MR25	METAL FILM
R 1726	5322 116 54641	19,6K	1	MR25	METAL FILM
R 1727	5322 116 50728	1,87K	1	MR25	METAL FILM
R 1728	5322 116 54532	649	1	MR25	METAL FILM
R 1729	5322 116 54462	82,5	1	MR25	METAL FILM
R 1731	5322 116 54619	10K	1	MR25	METAL FILM
R 1732	5322 116 54525	511	1	MR25	METAL FILM
R 1733	5322 116 54549	1K	1	MR25	METAL FILM
R 1734	5322 116 54519	402	1	MR25	METAL FILM
R 1736	5322 116 54723	187K	1	MR25	METAL FILM
R 1737	5322 101 14268	1M	20	0.75W	TRIMMING POTM
R 1738	5322 116 54549	1K	1	MR25	METAL FILM
R 1739	5322 116 54519	402	1	MR25	METAL FILM
R 1741	5322 116 54723	187K	1	MR25	METAL FILM
R 1742	5322 116 54525	511	1	MR25	METAL FILM
R 1743	5322 116 54462	82,5	1	MR25	METAL FILM
R 1744	5322 116 54619	10K	1	MR25	METAL FILM
R 1746	5322 116 54606	7,15K	1	MR25	METAL FILM
R 1747	5322 116 54532	649	1	MR25	METAL FILM
R 1748	5322 116 54619	10K	1	MR25	METAL FILM
R 1749	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 1801	5322 116 54743	301K	1	MR25	METAL FILM
R 1802	5322 116 54743	301K	1	MR25	METAL FILM
R 1803	4822 110 42187	1M	5	VR37	CARBON
R 1804	4822 112 21121	3,3K	5	4W	WIRE-WOUND
R 1806	5322 116 34051				NTC
R 1807	5322 116 54701	110K	1	MR25	METAL FILM
R 1808	5322 116 54701	110K	1	MR25	METAL FILM
R 1809	5322 116 54701	110K	1	MR25	METAL FILM
R 1811	5322 116 55337	1,62	1	MR25	METAL FILM
R 1812	5322 116 54469	100	1	MR25	METAL FILM
R 1813	5322 116 50491	22,6	1	MR25	METAL FILM
R 1814	5322 116 54351	20	5	PR52	METAL FILM
R 1816	5322 116 55205	2K	5	PR52	METAL FILM
R 1817	4822 110 63214	10M	10	CR25	CARBON
R 1818	4822 110 63214	10M	10	CR25	CARBON
R 1819	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1822	5322 116 50629	1,74K	1	MR25	METAL FILM
R 1823	5322 116 54696	100K	1	MR25	METAL FILM
R 1824	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1826	5322 100 10135	470	20	0.75W	TRIMMING POTM
R 1827	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1828	5322 116 50593	16,2K	1	MR25	METAL FILM
R 1829	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1830	5322 116 50482	33,2K	1	MR25	METAL FILM
R 1831	5322 116 50583	5,9K	1	MR25	METAL FILM
R 1832	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1833	5322 116 54012	6,81K	1	MR25	METAL FILM
R 1834	5322 116 54499	249	1	MR25	METAL FILM
R 1836	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1837	5322 116 54499	249	1	MR25	METAL FILM
R 1838	5322 116 54484	140	1	MR25	METAL FILM
R 1839	4822 110 63027	1	5	CR25	CARBON
R 1846	5322 116 54704	121K	1	MR25	METAL FILM
R 1847	5322 116 54704	121K	1	MR25	METAL FILM

R 1848	4822 110 63187	1M	5	CR25	CARBON
R 1849	5322 116 54619	10K	1	MR25	METAL FILM
R 1851	5322 116 54683	68,1K	1	MR25	METAL FILM
R 1852	5322 116 54734	249K	1	MR25	METAL FILM
R 1853	5322 116 55258	511K	1	MR25	METAL FILM
R 1854	4822 110 63187	1M	5	CR25	CARBON
R 1856	5322 116 54561	1,33K	1	MR25	METAL FILM
R 1857	5322 116 54561	1,33K	1	MR25	METAL FILM
R 1858	5322 116 54549	1K	1	MR25	METAL FILM
R 1861	4822 110 42214	10M	5	VR37	CARBON
R 1901	5322 116 54462	82,5	1	MR25	METAL FILM
R 1902	5322 116 54641	19,6K	1	MR25	METAL FILM
R 1903	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1904	5322 116 54511	316	1	MR25	METAL FILM
R 1906	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1907	5322 116 54536	750	1	MR25	METAL FILM
R 1908	5322 116 54561	1,33K	1	MR25	METAL FILM
R 1909	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1911	5322 116 54549	1K	1	MR25	METAL FILM
R 1912	5322 116 54469	100	1	MR25	METAL FILM
R 1913	5322 116 54549	1K	1	MR25	METAL FILM
R 2001	5322 116 54567	1,69K	1	MR25	METAL FILM
R 2002	5322 116 51052	42,2	1	MR25	METAL FILM
R 2003	5322 116 51052	42,2	1	MR25	METAL FILM
R 2004	5322 116 50491	22,6	1	MR25	METAL FILM
R 2006	5322 116 54619	10K	1	MR25	METAL FILM
R 2007	5322 116 50481	22,6K	1	MR25	METAL FILM
R 2008	5322 116 54525	511	1	MR25	METAL FILM
R 2009	5322 116 50671	2,61K	1	MR25	METAL FILM
R 2011	5322 116 54567	1,69K	1	MR25	METAL FILM
R 2014	5322 116 50484	4,64K	1	MR25	METAL FILM
R 2016	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2017	5322 116 50536	464	1	MR25	METAL FILM
R 2018	5322 116 50664	2,05K	1	MR25	METAL FILM
R 2019	5322 116 50669	205	1	MR25	METAL FILM
R 2021	5322 116 50572	12,1K	1	MR25	METAL FILM
R 2022	5322 116 54536	750	1	MR25	METAL FILM
R 2023	5322 116 54557	1,21K	1	MR25	METAL FILM
R 2024	5322 116 50583	5,9K	1	MR25	METAL FILM
R 2026	5322 116 50491	22,6	1	MR25	METAL FILM
R 2027	4822 122 30103				CERAMIC PLATE
R 2028	5322 116 50572	12,1K	1	MR25	METAL FILM
R 2029	5322 116 54009	562	1	MR25	METAL FILM
R 2030	5322 116 54549	1K	1	MR25	METAL FILM
R 2031	5322 116 54683	68,1K	1	MR25	METAL FILM
R 2032	5322 116 54592	4,02K	1	MR25	METAL FILM
R 2033	5322 116 54549	1K	1	MR25	METAL FILM
R 2034	5322 116 54469	100	1	MR25	METAL FILM
R 2037	5322 101 14094	1M	20	0,5W	TRIMMING POTM
R 2038	5322 116 50491	22,6	1	MR25	METAL FILM
R 2039	5322 101 14268	1M	20	0.75W	TRIMMING POTM
R 2041	5322 116 54549	1K	1	MR25	METAL FILM
R 2042	5322 116 54549	1K	1	MR25	METAL FILM
R 2043	5322 116 50482	33,2K	1	MR25	METAL FILM
R 2044	5322 116 50491	22,6	1	MR25	METAL FILM
R 2046	5322 116 54692	86,6K	1	MR25	METAL FILM
R 2047	5322 116 54743	301K	1	MR25	METAL FILM
R 2048	5322 101 14071	100K	20	0.5W	TRIMMING POTM
R 2049	5322 116 50481	22,6K	1	MR25	METAL FILM
R 2050	5322 116 54619	10K	1	MR25	METAL FILM
R 2051	4822 110 42218	15M	5	VR37	CARBON
R 2052	5322 116 54595	5,11K	1	MR25	METAL FILM
R 2053	5322 116 54595	5,11K	1	MR25	METAL FILM
R 2054	5322 116 54549	1K	1	MR25	METAL FILM
R 2056	5322 116 50558	18,7K	1	MR25	METAL FILM
R 2057	5322 116 54678	59K	1	MR25	METAL FILM
R 2058	5322 116 54743	301K	1	MR25	METAL FILM
R 2059	5322 116 50536	464	1	MR25	METAL FILM
R 2060	4822 110 42223	22M	5	VR37	CARBON
R 2061	5322 116 54561	1,33K	1	MR25	METAL FILM
R 2062	5322 116 54696	100K	1	MR25	METAL FILM
R 2063	5322 116 50491	22,6	1	MR25	METAL FILM
R 2064	5322 116 54683	68,1K	1	MR25	METAL FILM
R 2065	5322 116 54696	100K	1	MR25	METAL FILM
R 2067	5322 116 50572	12,1K	1	MR25	METAL FILM
R 2068	5322 116 50491	22,6	1	MR25	METAL FILM

R 2069	5322 116 54678	59K	1	MR25	METAL FILM
R 2071	5322 101 14071	100K	20	0.5W	TRIMMING POTM
R 2072	4822 110 42214	10M	5	VR37	CARBON
R 2073	4822 110 42218	15M	5	VR37	CARBON
R 2077	5322 116 54619	10K	1	MR25	METAL FILM
R 2078	4822 110 63187	1M	5	CR25	CARBON
R 2079	4822 110 63187	1M	5	CR25	CARBON
R 2081	5322 116 54549	1K	1	MR25	METAL FILM
R 2082	5322 116 54549	1K	1	MR25	METAL FILM
R 2083	5322 116 54743	301K	1	MR25	METAL FILM
R 2084	5322 116 55284	681K	1	MR25	METAL FILM
R 2086	5322 116 54619	10K	1	MR25	METAL FILM
R 2087	5322 116 54469	100	1	MR25	METAL FILM
R 2088	5322 116 54696	100K	1	MR25	METAL FILM
R 2089	5322 116 54696	100K	1	MR25	METAL FILM
R 2091	5322 116 50491	22,6	1	MR25	METAL FILM
R 2092	5322 116 50491	22,6	1	MR25	METAL FILM
R 2093	5322 116 50491	22,6	1	MR25	METAL FILM
R 2094	5322 116 50491	22,6	1	MR25	METAL FILM
R 2095	5322 116 54619	10K	1	MR25	METAL FILM
R 2096	5322 116 50491	22,6	1	MR25	METAL FILM
R 2097	5322 116 50491	22,6	1	MR25	METAL FILM
R 2098	5322 116 50479	15,4K	1	MR25	METAL FILM
R 2099	5322 116 50527	33,2	1	MR25	METAL FILM
R 2100	5322 116 50527	33,2	1	MR25	METAL FILM
R 2101	5322 116 54504	274	1	MR25	METAL FILM

SEMI CONDUCTORS

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
V 1	5322 131 24047	85D14GH
V 2	4822 130 31144	CQY24B-III
V 3	4822 130 31144	CQY24B-III
V 4	4822 130 31144	CQY24B-III
V 5	4822 130 31144	CQY24B-III
V 6	4822 130 31144	CQY24B-III
V 7	4822 130 31144	CQY24B-III
V 101	5322 130 34037	BAV45
V 102	5322 130 44605	ON471
V 103	5322 130 44459	BFT25R
V 104	5322 130 44178	BFR92
V 151	5322 130 34037	BAV45
V 152	5322 130 44605	ON471
V 153	5322 130 44458	BFT25
V 154	5322 130 44606	BFR92R
V 201	4822 130 30613	BAW62
V 202	4822 130 30613	BAW62
V 203	5322 130 44711	BFT92
V 204	5322 130 44713	BFT92R
V 206	5322 130 34331	BAV70
V 207	5322 130 34331	BAV70
V 208	4822 130 34047	BZX75-C1V4
V 209	4822 130 30613	BAW62
V 211	4822 130 30613	BAW62
V 212	4822 130 30613	BAW62
V 213	4822 130 30613	BAW62
V 214	5322 130 44337	BCW33
V 216	5322 130 44335	BCW30
V 221	4822 130 30613	BAW62
V 301	4822 130 30613	BAW62
V 302	4822 130 30613	BAW62
V 303	5322 130 44711	BFT92
V 304	5322 130 44713	BFT92R
V 306	5322 130 34331	BAV70
V 307	5322 130 34331	BAV70
V 308	4822 130 34047	BZX75-C1V4
V 309	4822 130 30613	BAW62
V 311	4822 130 30613	BAW62
V 312	4822 130 30613	BAW62
V 313	4822 130 30613	BAW62
V 314	5322 130 44342	BCW33R
V 316	5322 130 44341	BCW30R
V 321	4822 130 30613	BAW62
V 401	5322 130 44337	BCW33
V 402	4822 130 34233	BZX79-C5V1
V 403	5322 130 34331	BAV70
V 404	5322 130 34331	BAV70
V 406	4822 130 34047	BZX75-C1V4
V 407	5322 130 44335	BCW30
V 408	5322 130 44337	BCW33
V 409	5322 130 44337	BCW33
V 451	5322 130 44342	BCW33R
V 452	4822 130 34233	BZX79-C5V1
V 453	5322 130 34331	BAV70
V 454	5322 130 34331	BAV70
V 456	4822 130 34047	BZX75-C1V4
V 457	5322 130 44341	BCW30R
V 458	5322 130 44342	BCW33R
V 501	5322 130 44341	BCW30R
V 502	5322 130 44713	BFT92R
V 503	5322 130 44335	BCW30
V 504	5322 130 44711	BFT92
V 505	5322 130 34302	BA280
V 506	5322 130 44342	BCW33R
V 507	4822 130 30613	BAW62
V 510	5322 130 34302	BA280
V 601	5322 130 44713	BFT92R
V 602	5322 130 44711	BFT92

V 603	4822 130 44246	BC549C
V 604	4822 130 30613	BAW62
V 606	4822 130 44246	BC549C
V 607	4822 130 44246	BC549C
V 608	4822 130 44358	BC559B
V 609	5322 130 34689	BBY31
V 611	5322 130 34689	BBY31
V 612	4822 130 30765	BZX75-C3V6
V 613	5322 130 30772	BZX87-C5V6
V 614	5322 130 30772	BZX87-C5V6
V 701	5322 130 44476	BC264A
V 702	4822 130 44358	BC559B
V 703	4822 130 44358	BC559B
V 704	4822 130 44358	BC559B
V 705	4822 130 34049	BZX75-C2V1
V 706	4822 130 44246	BC549C
V 707	4822 130 30613	BAW62
V 708	4822 130 30613	BAW62
V 709	4822 130 30613	BAW62
V 711	5322 130 40493	BFY90
V 712	5322 130 40493	BFY90
V 801	4822 130 44358	BC559B
V 802	5322 130 30691	BAW56
V 803	5322 130 44711	BFT92
V 804	5322 130 44713	BFT92R
V 806	5322 130 44178	BFR92
V 807	5322 130 44396	BF324
V 808	4822 130 30613	BAW62
V 809	5322 130 30691	BAW56
V 811	4822 130 30613	BAW62
V 812	5322 130 30691	BAW56
V 813	5322 130 44713	BFT92R
V 814	5322 130 44606	BFR92R
V 816	5322 130 44178	BFR92
V 817	5322 130 44178	BFR92
V 818	5322 130 44606	BFR92R
V 819	5322 130 34337	BAV99
V 821	5322 130 44178	BFR92
V 822	5322 130 44606	BFR92R
V 823	5322 130 44606	BFR92R
V 824	5322 130 44178	BFR92
V 826	5322 130 44713	BFT92R
V 827	5322 130 44713	BFT92R
V 828	4822 130 30613	BAW62
V 829	4822 130 44246	BC549C
V 831	4822 130 30613	BAW62
V 901	4822 130 30613	BAW62
V 902	4822 130 44246	BC549C
V 903	5322 130 40417	BSX20
V 904	4822 130 30613	BAW62
V 906	5322 130 40417	BSX20
V 907	5322 130 40417	BSX20
V 908	4822 130 44246	BC549C
V 909	4822 130 30613	BAW62
V 910	4822 130 30613	BAW62
V 911	4822 130 44246	BC549C
V 912	4822 130 30613	BAW62
V 913	4822 130 44358	BC559B
V 914	4822 130 44358	BC559B
V 916	4822 130 44246	BC549C
V 917	4822 130 30613	BAW62
V 918	5322 130 44073	BCY59
V 919	4822 130 44246	BC549C
V 921	4822 130 30613	BAW62
V 922	4822 130 44246	BC549C
V 923	4822 130 44246	BC549C
V 924	4822 130 44358	BC559B
V 925	4822 130 30613	BAW62
V 926	4822 130 30613	BAW62
V 927	4822 130 30613	BAW62

V 928	5322 130 40417	BSX20
V 929	5322 130 44396	BF324
V 930	4822 130 30613	BAW62
V 931	5322 130 44396	BF324
V 932	4822 130 30613	BAW62
V 933	4822 130 30613	BAW62
V 934	4822 130 44358	BC559B
V 935	4822 130 30613	BAW62
V 936	4822 130 44246	BC549C
V 937	4822 130 44246	BC549C
V 938	4822 130 30613	BAW62
V 939	4822 130 44358	BC559B
V 940	4822 130 30613	BAW62
V 941	4822 130 30613	BAW62
V 942	4822 130 30613	BAW62
V 943	4822 130 30613	BAW62
V 944	5322 130 44396	BF324
V 945	4822 130 44246	BC549C
V 946	4822 130 30613	BAW62
V 948	4822 130 44246	BC549C
V 949	4822 130 44246	BC549C
V 950	4822 130 30613	BAW62
V 951	4822 130 44246	BC549C
V 952	4822 130 44246	BC549C
V 953	4822 130 30613	BAW62
V 954	4822 130 44358	BC559B
V 956	4822 130 44246	BC549C
V 957	4822 130 30613	BAW62
V 958	4822 130 30613	BAW62
V 959	4822 130 44358	BC559B
V 960	4822 130 30613	BAW62
V 961	4822 130 44358	BC559B
V 962	4822 130 30613	BAW62
V 963	4822 130 30613	BAW62
V 964	4822 130 44246	BC549C

V 1101	5322 130 44476	BC264A
V 1102	4822 130 44358	BC559B
V 1103	4822 130 30613	BAW62
V 1104	5322 130 40493	BFY90
V 1201	5322 130 44396	BF324
V 1202	5322 130 30691	BAW56
V 1203	5322 130 44713	BFT92R
V 1204	5322 130 44711	BFT92
V 1206	5322 130 44606	BFR92R
V 1207	4822 130 30613	BAW62
V 1208	5322 130 30691	BAW56
V 1209	5322 130 30691	BAW56
V 1211	4822 130 30613	BAW62
V 1212	5322 130 44711	BFT92
V 1213	5322 130 44606	BFR92R
V 1214	5322 130 44178	BFR92
V 1216	5322 130 34337	BAV99
V 1217	5322 130 44606	BFR92R
V 1218	5322 130 44178	BFR92
V 1219	5322 130 44606	BFR92R
V 1221	5322 130 44711	BFT92
V 1222	5322 130 44178	BFR92
V 1223	5322 130 44711	BFT92
V 1224	4822 130 30613	BAW62
V 1226	4822 130 30613	BAW62
V 1227	4822 130 44246	BC549C
V 1300	4822 130 44358	BC559B
V 1301	4822 130 30613	BAW62
V 1302	4822 130 30613	BAW62
V 1303	4822 130 30613	BAW62
V 1304	5322 130 44396	BF324
V 1305	4822 130 30613	BAW62
V 1306	4822 130 30613	BAW62
V 1307	4822 130 44246	BC549C
V 1308	5322 130 40417	BSX20

V 1309	5322 130 40417	BSX20
V 1311	5322 130 40417	BSX20
V 1312	4822 130 44246	BC549C
V 1313	4822 130 30613	BAW62
V 1314	4822 130 44246	BC549C
V 1316	4822 130 30613	BAW62
V 1317	4822 130 44358	BC559B
V 1318	4822 130 44358	BC559B
V 1319	4822 130 44246	BC549C
V 1321	4822 130 30613	BAW62
V 1322	5322 130 44073	BCY59
V 1323	4822 130 44246	BC549C
V 1324	4822 130 30613	BAW62
V 1326	4822 130 44246	BC549C
V 1327	4822 130 44246	BC549C
V 1328	4822 130 44358	BC559B
V 1329	4822 130 30613	BAW62
V 1331	4822 130 30613	BAW62
V 1332	4822 130 30613	BAW62
V 1336	4822 130 44358	BC559B
V 1337	4822 130 30613	BAW62
V 1338	4822 130 30613	BAW62
V 1339	4822 130 44246	BC549C
V 1501	4822 130 44246	BC549C
V 1502	4822 130 44358	BC559B
V 1503	4822 130 30613	BAW62
V 1504	4822 130 30613	BAW62
V 1506	4822 130 44358	BC559B
V 1507	4822 130 30613	BAW62
V 1508	4822 130 30613	BAW62
V 1509	4822 130 44246	BC549C
V 1511	4822 130 44358	BC559B
V 1512	4822 130 44358	BC559B
V 1513	4822 130 30613	BAW62
V 1514	4822 130 30613	BAW62
V 1515	4822 130 30613	BAW62
V 1516	4822 130 44358	BC559B
V 1517	4822 130 44358	BC559B
V 1518	4822 130 30613	BAW62
V 1519	4822 130 44246	BC549C
V 1520	4822 130 44246	BC549C
V 1521	4822 130 44358	BC559B
V 1522	4822 130 30613	BAW62
V 1523	4822 130 34382	BZX79-C8V2
V 1524	4822 130 44358	BC559B
V 1526	4822 130 30613	BAW62
V 1527	5322 130 44396	BF324
V 1528	4822 130 30613	BAW62
V 1529	4822 130 30613	BAW62
V 1551	4822 130 30613	BAW62
V 1552	4822 130 34167	BZX79-B6V2
V 1553	4822 130 30613	BAW62
V 1554	4822 130 30613	BAW62
V 1556	4822 130 30613	BAW62
V 1557	4822 130 30613	BAW62
V 1558	4822 130 30613	BAW62
V 1559	4822 130 40645	BD135
V 1561	4822 130 44358	BC559B
V 1562	4822 130 40645	BD135
V 1563	4822 130 30613	BAW62
V 1564	4822 130 34167	BZX79-B6V2
V 1566	4822 130 30613	BAW62
V 1567	4822 130 40712	BD136
V 1568	4822 130 40712	BD136
V 1601	5322 130 40417	BSX20
V 1602	5322 130 34605	BAX12A
V 1651	5322 130 34397	BZX91
V 1652	4822 130 34197	BZX79-C12
V 1654	4822 130 44421	BD436
V 1656	4822 130 44465	BD435

V 1657	5322	130	34397	BZX91
V 1658	4822	130	34197	BZX79-C12
V 1661	4822	130	44465	BD435
V 1662	4822	130	44421	BD436
V 1701	4822	130	44246	BC549C
V 1702	4822	130	44246	BC549C
V 1703	4822	130	44246	BC549C
V 1704	4822	130	44358	BC559B
V 1706	4822	130	40968	BSS38
V 1707	5322	130	44247	BSS68
V 1708	5322	130	44247	BSS68
V 1709	4822	130	40968	BSS38
V 1711	4822	130	30613	BAW62
V 1712	4822	130	34049	BZX75-C2V1
V 1713	4822	130	30613	BAW62
V 1714	4822	130	40968	BSS38
V 1716	5322	130	44247	BSS68
V 1717	5322	130	44247	BSS68
V 1718	4822	130	40968	BSS38
V 1801	5322	130	34761	BY224-600
V 1802	4822	130	34197	BZX79-C12
V 1803	5322	130	44718	BUX86
V 1804	4822	130	44246	BC549C
V 1806	4822	130	44508	BU208
V 1807	5322	130	34605	BAX12
V 1808	4822	130	31051	BY208-1000
V 1809	4822	130	31051	BY208-1000
V 1811	4822	130	31051	BY208-1000
V 1812	4822	130	44246	BC549C
V 1813	4822	130	34197	BZX79-C12
V 1814	4822	130	30613	BAW62
V 1816	4822	130	30839	BY206
V 1817	4822	130	30839	BY206
V 1818	4822	130	30839	BY206
V 1819	4822	130	30839	BY206
V 1826	4822	130	30817	BYX55-600
V 1827	4822	130	30839	BY206
V 1828	4822	130	30839	BY206
V 1829	4822	130	30817	BYX55-600
V 1831	4822	130	30817	BYX55-600
V 1832	4822	130	30817	BYX55-600
V 1833	4822	130	30817	BYX55-600
V 1834	4822	130	30817	BYX55-600
V 1836	4822	130	30839	BY206
V 1837	4822	130	30839	BY206
V 1838	4822	130	30839	BY206
V 1839	4822	130	30839	BY206
V 1841	4822	130	30613	BAW62
V 1842	5322	130	94015	H11A550
V 1843	4822	130	44246	BC549C
V 1844	4822	130	44246	BC549C
V 1846	4822	130	44246	BC549C
V 1851	5322	130	34594	BY409
V 1852	5322	130	34594	BY409
V 1853	5322	130	34594	BY409
V 1854	5322	130	34594	BY409
V 1856	5322	130	34594	BY409
V 1857	5322	130	34594	BY409
V 1858	5322	130	34594	BY409
V 1859	5322	130	34594	BY409
V 1861	5322	130	34594	BY409
V 1901	4822	130	34173	BZX79-C5V6
V 2001	4822	130	30613	BAW62
V 2002	5322	130	40417	BSX20
V 2003	5322	130	40417	BSX20
V 2004	4822	130	44358	BC559B
V 2006	5322	130	44396	BF324
V 2007	4822	130	34049	BZX75-C2V1
V 2008	4822	130	40968	BSS38
V 2009	4822	130	40968	BSS38

V 2011	5322 130 44396	BF324
V 2012	5322 130 44396	BF324
V 2013	4822 130 40968	BSS38
V 2014	5322 130 44247	BSS68
V 2015	4822 130 34173	BZX79-C5V6
V 2016	4822 130 40968	BSS38
V 2017	4822 130 40968	BSS38
V 2018	5322 130 34594	BY409
V 2019	5322 130 34594	BY409
V 2021	5322 130 34605	BAX12
V 2022	5322 130 34605	BAX12
V 2023	4822 130 41207	BD232
V 2024	4822 130 44246	BC549C
V 2026	4822 130 44358	BC559B
V 2027	4822 130 30195	BYX10
V 2029	5322 130 44712	V103R2
V 2031	4822 130 30613	BAW62
V 2032	5322 130 30605	BAX17
V 2033	5322 130 44247	BSS68
V 2034	4822 130 40968	BSS38
V 2035	4822 130 34189	BAV20
V 2036	4822 130 40968	BSS38
V 2037	4822 130 30613	BAW62
V 2038	5322 130 30605	BAX17
V 2039	5322 130 30605	BAX17
V 2041	5322 130 30605	BAX17
V 2042	5322 130 30605	BAX17
V 2043	4822 130 44246	BC549C
V 2044	4822 130 44358	BC559B
V 2046	5322 130 44749	BD680

INTEGRATED CIRUITS

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
D 101	5322 209 85475	LM208H
D 102	5322 116 94021	TF CIRC
D 151	5322 209 85475	LM208H
D 152	5322 116 94021	TF CIRC
D 201	5322 209 85484	OQ 012
D 202	5322 209 85484	OQ 012
D 203	5322 209 85484	OQ 012
D 301	5322 209 85484	OQ 012
D 302	5322 209 85484	OQ 012
D 303	5322 209 85484	OQ 012
D 401	5322 209 85484	OQ 012
D 451	5322 209 85484	OQ 012
D 501	5322 209 85484	OQ 012
D 601	5322 209 85484	OQ 012
D 602	5322 216 54192	OM504
D 603	5322 255 44246	HIC-P5185
D 701	5322 209 84659	LM308T
D 801	5322 209 84659	LM308T
D 802	5322 209 86012	GXB10104P
D 901	5322 209 86003	10231BA
D 902	5322 209 85955	GXB10102D
D 903	5322 209 84659	LM308T
D 904	5322 209 84659	LM308T
D 906	5322 209 85254	UA741CN
D 1101	5322 209 84659	LM308T
D 1201	5322 209 84659	LM308T
D 1301	5322 209 84659	LM308T
D 1302	5322 209 84659	LM308T
D 1303	5322 209 84111	CA3086
D 1304	5322 209 84659	LM308T
D 1551	5322 209 84386	TCA220
D 1552	5322 209 84386	TCA220

D 1601	5322 209 84823	N74LS00N
D 1602	5322 209 85312	N74LS02N
D 1603	5322 209 85312	N74LS02N
D 1604	5322 209 85527	N74LS76N
D 1606	5322 209 84823	N74LS00N
D 1607	5322 209 84823	N74LS00N
D 1608	5322 209 84823	N74LS00N
D 1609	5322 209 85527	N74LS76N
D 1651	5322 209 85899	LM324N
D 1801	5322 209 86175	TDA1060R
D 1901	5322 209 84452	UA709CH

MISCELLANEOUS

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
E 1	5322 134 44177	
E 2	5322 134 44177	
F 1	4822 253 30025	
K 1701	5322 280 24076	RELAY COIL
L 1	5322 157 44035	COIL ASSEMBLY
L 601	5322 321 24901	COIL
L 602	5322 321 24901	COIL
L 1801	5322 156 14076	COIL
L 1802	5322 156 14076	COIL
L 1803	5322 142 44026	COIL
L 1804	5322 281 64154	COIL
L 1806	5322 148 84041	TRANSFORMER
L 1807	5322 152 24062	TRANSFORMER
L 1811	4822 156 20663	COIL
L 1812	4822 156 20663	COIL
L 1813	4822 156 20663	COIL
L 1814	4822 156 20663	COIL
L 1816	5322 152 24067	CHOKE
L 1817	5322 152 24068	CHOKE
S 1	5322 276 64029	SWITCH
S 2	5322 276 44063	SWITCH
S 8	5322 276 34043	SWITCH
S 9	5322 273 34116	SWITCH
S 11	5322 273 34116	SWITCH
S 13	5322 273 44098	SWITCH
S 15	5322 273 44097	SWITCH
S 19	5322 276 64031	SWITCH
S 21	5322 276 84063	SWITCH
S 1801	5322 277 24071	SWITCH
T 1801	5322 148 84039	TRANSFORMER

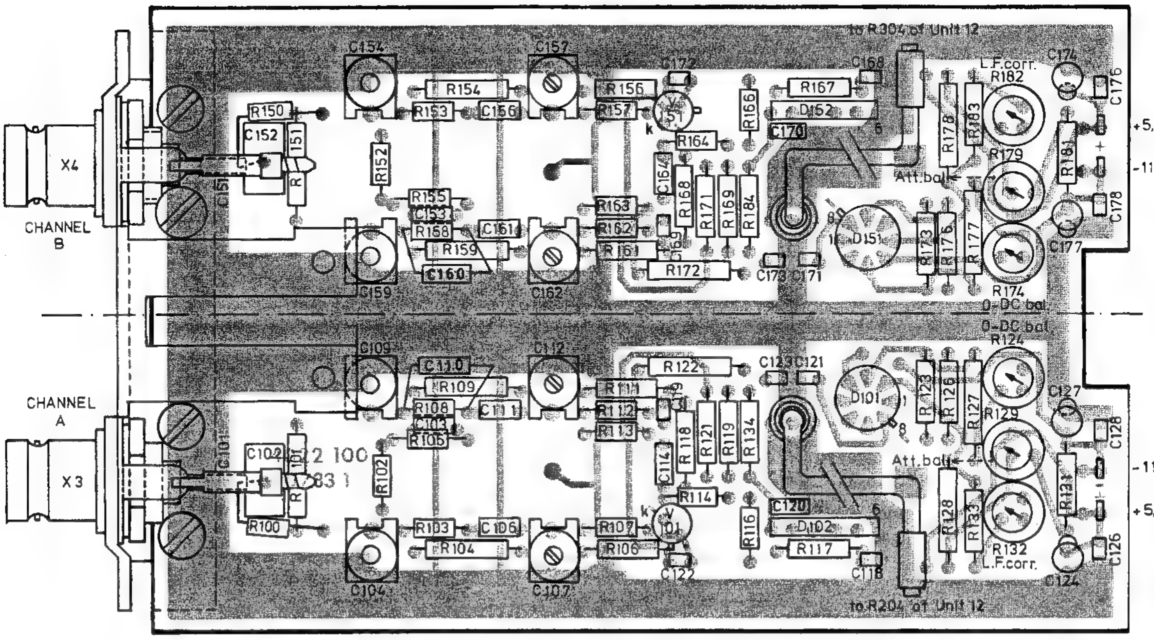


Fig. 3.39 . Vertical attenuator component side (UNIT 2)

MAT 47 A

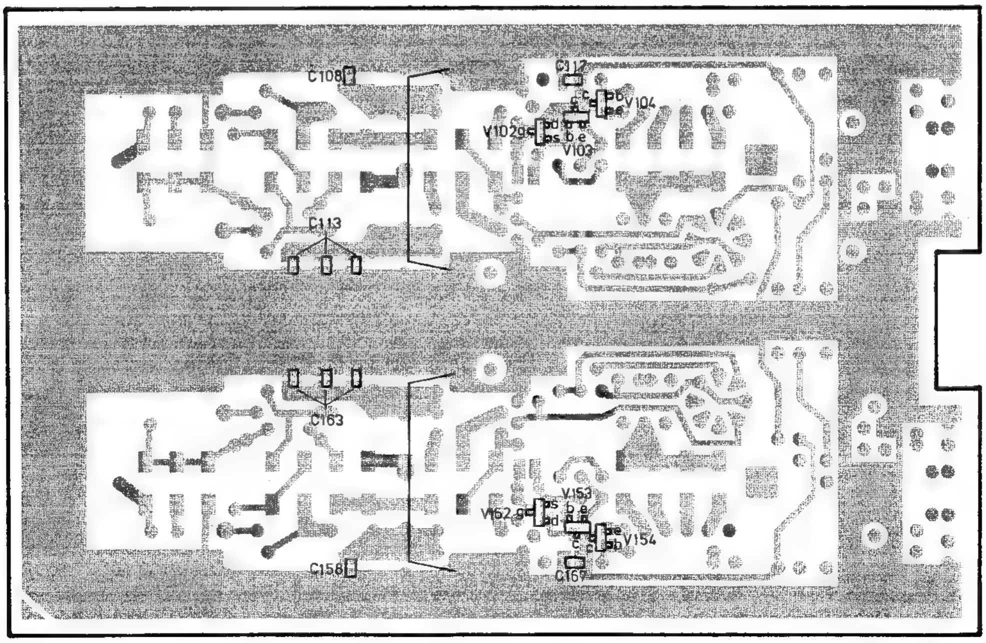
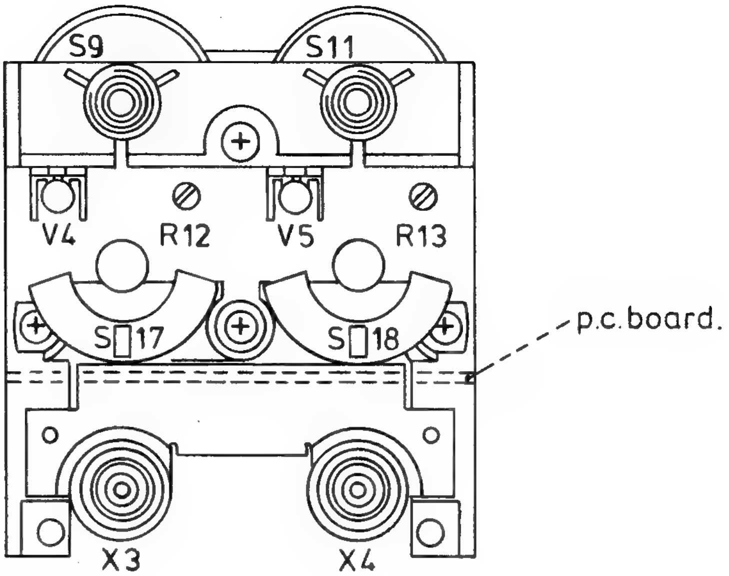


Fig. 3.40. Vertical attenuator conductor side (UNIT 2)

MAT48 A



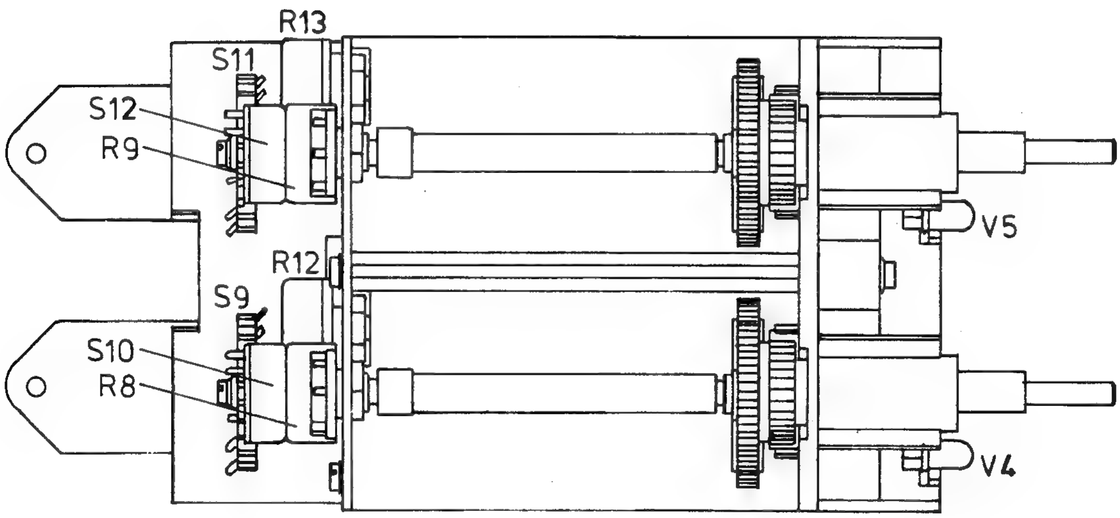


Fig. 3.41. Vertical attenuator (UNIT 2)

MAT 49

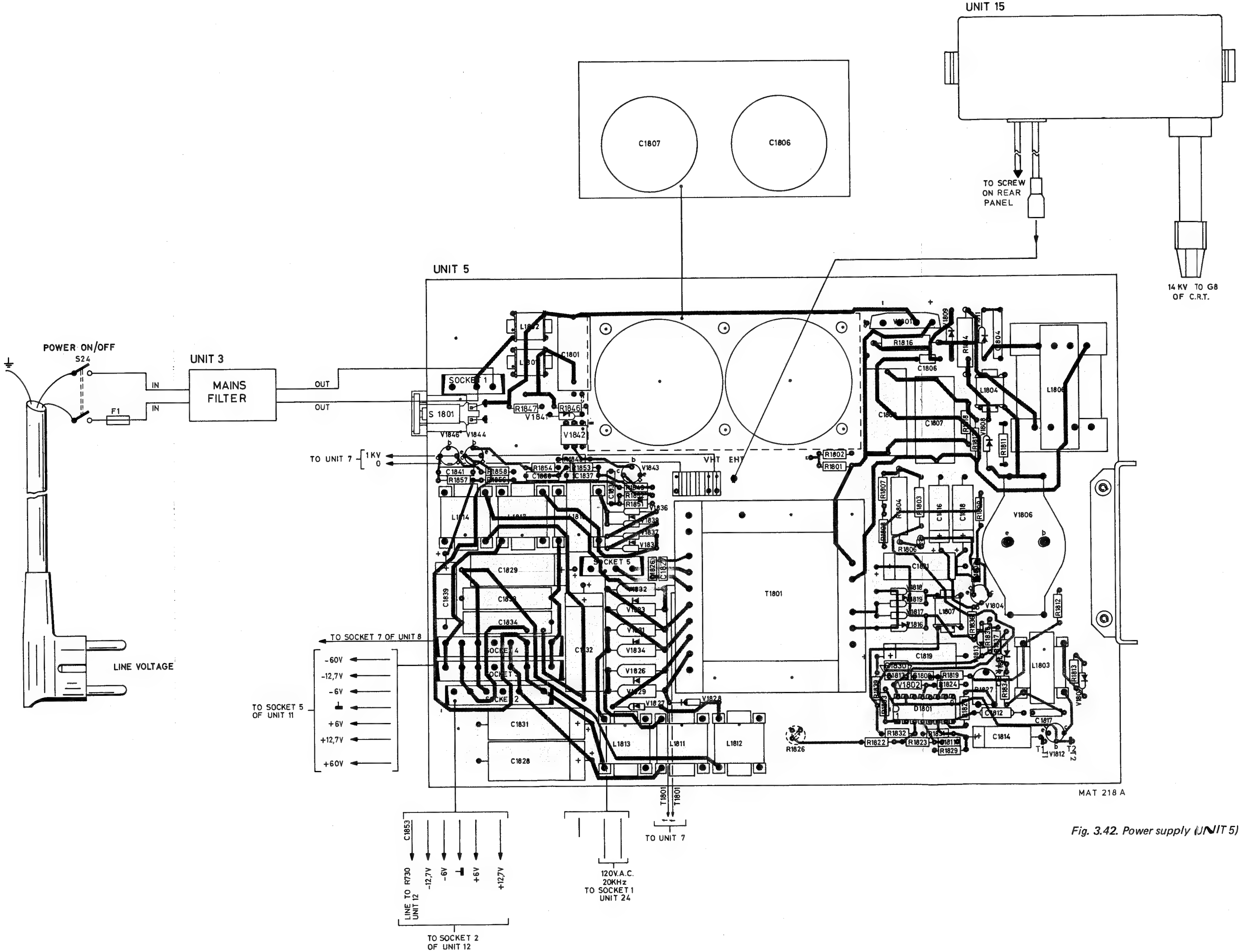


Fig. 3.42. Power supply (UNIT 5)

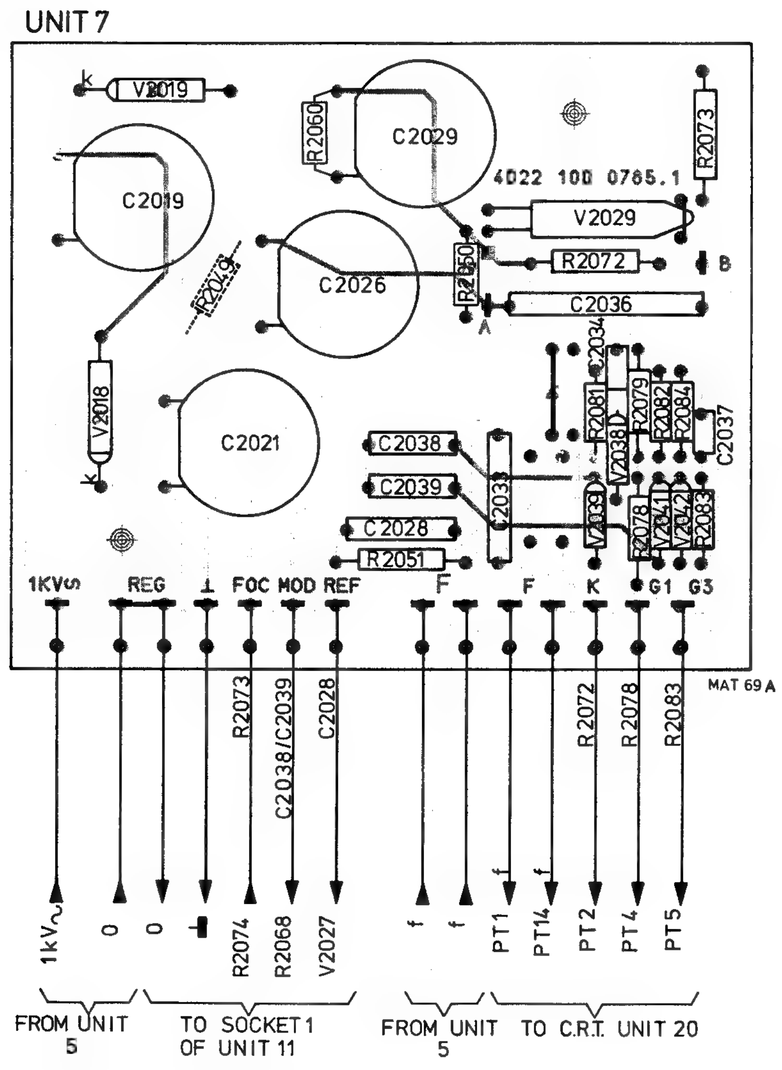


Fig. 3.43. Focus unit (UNIT 7)

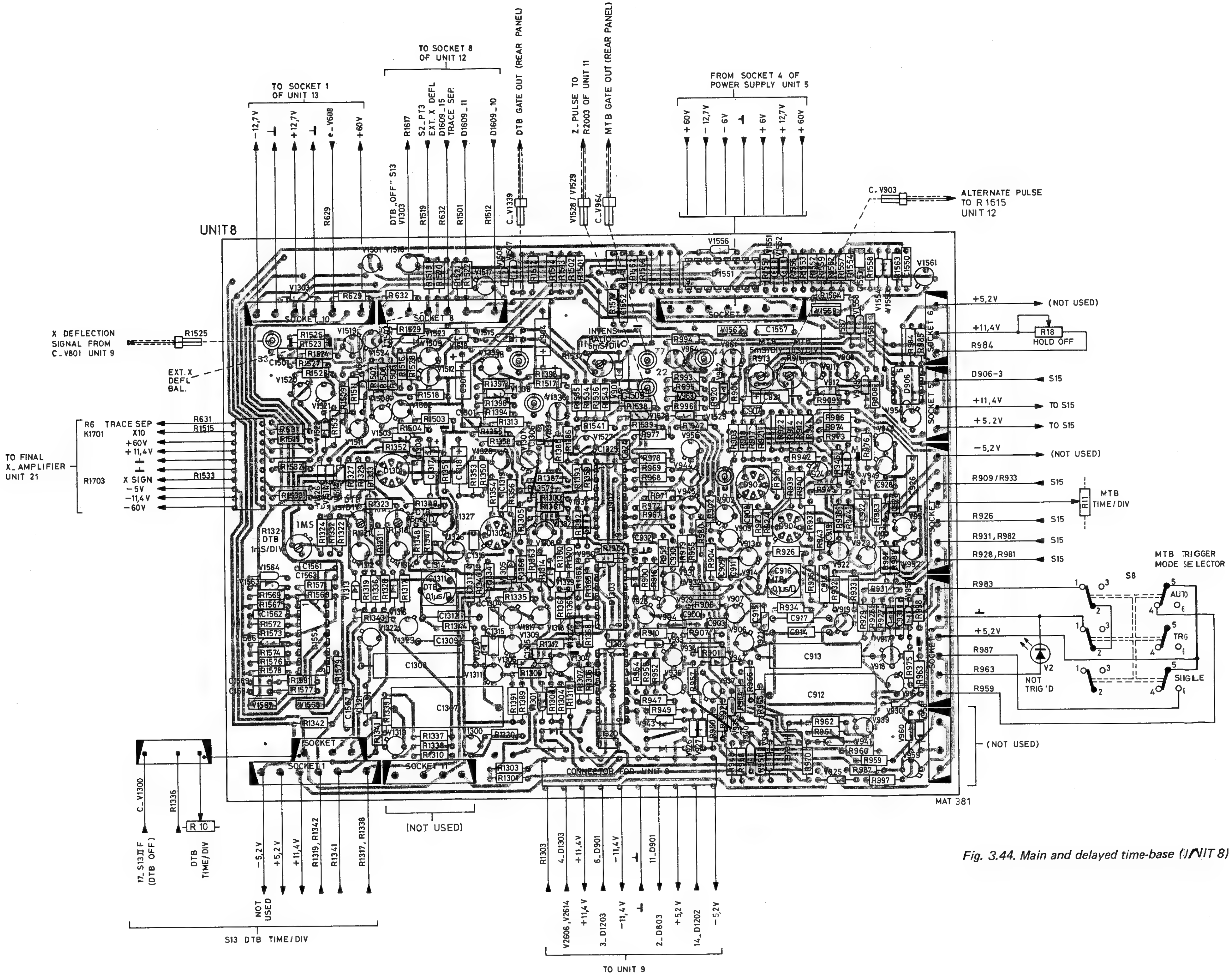


Fig. 3.44. Main and delayed time-base (UNIT 8)

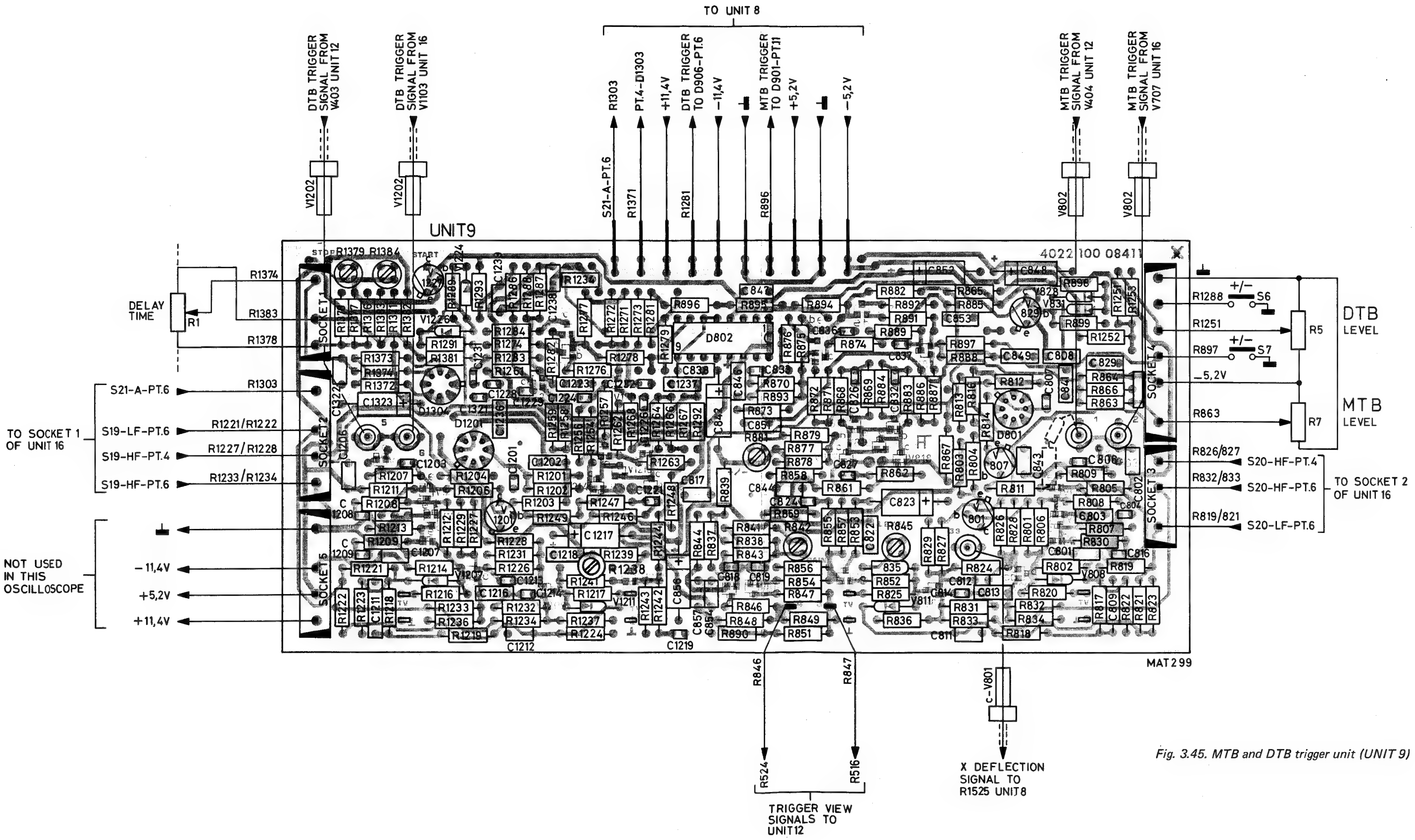


Fig. 3.45. MTB and DTB trigger unit (UNIT 9)

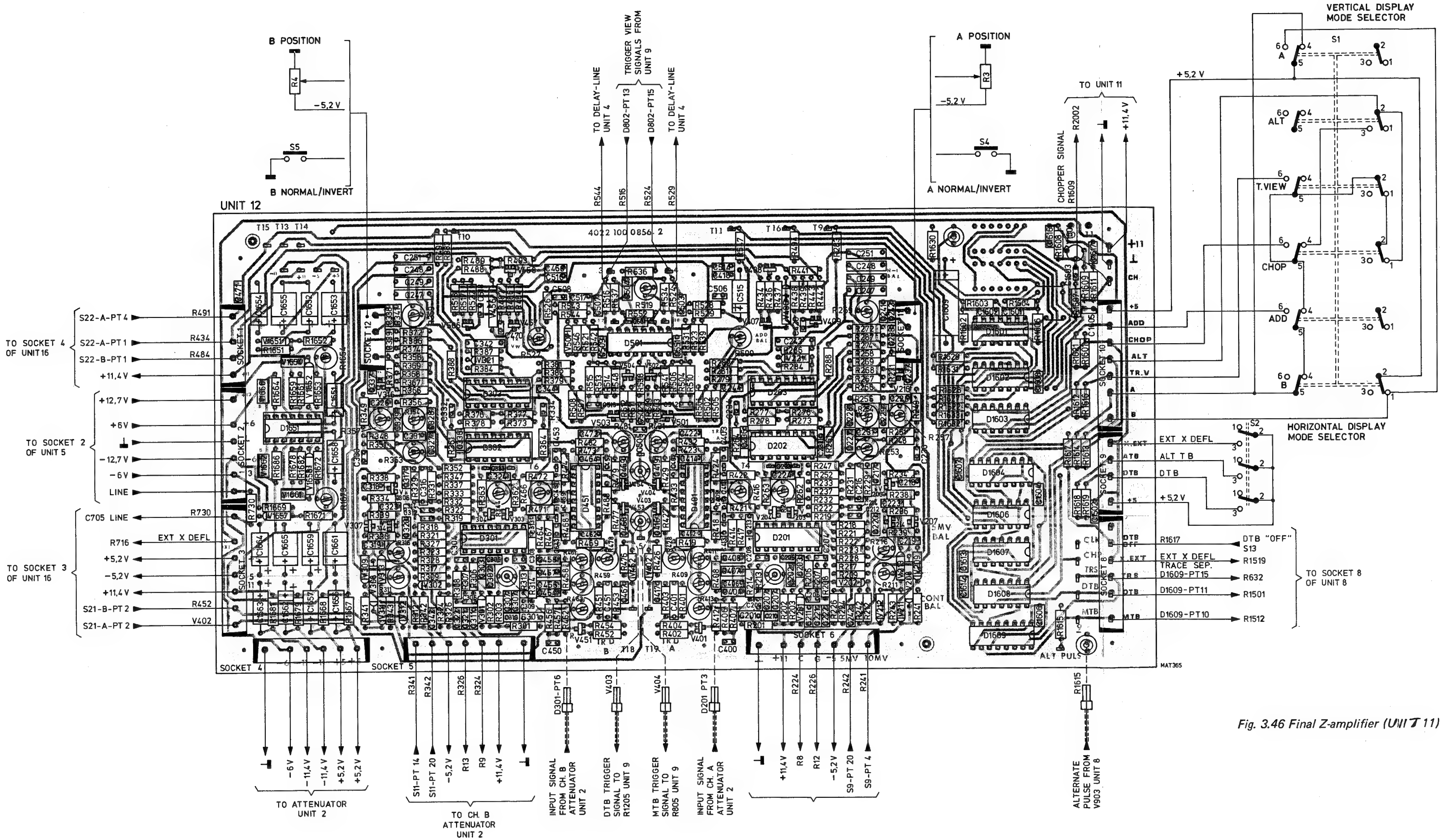


Fig. 3.46 Final Z-amplifier (UNIT 11)

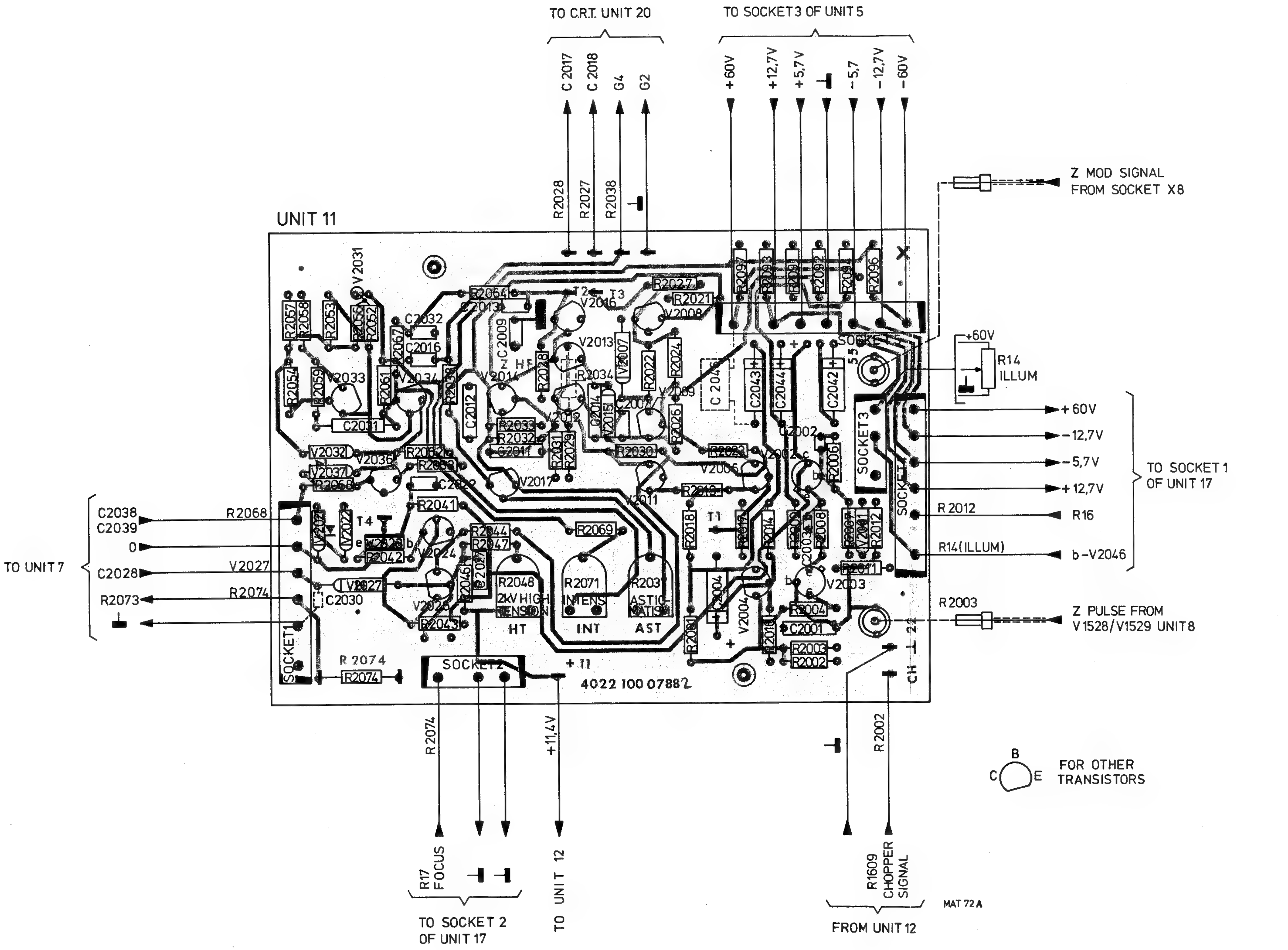


Fig. 3.47. Intermediate amplifier (UNIT 12)

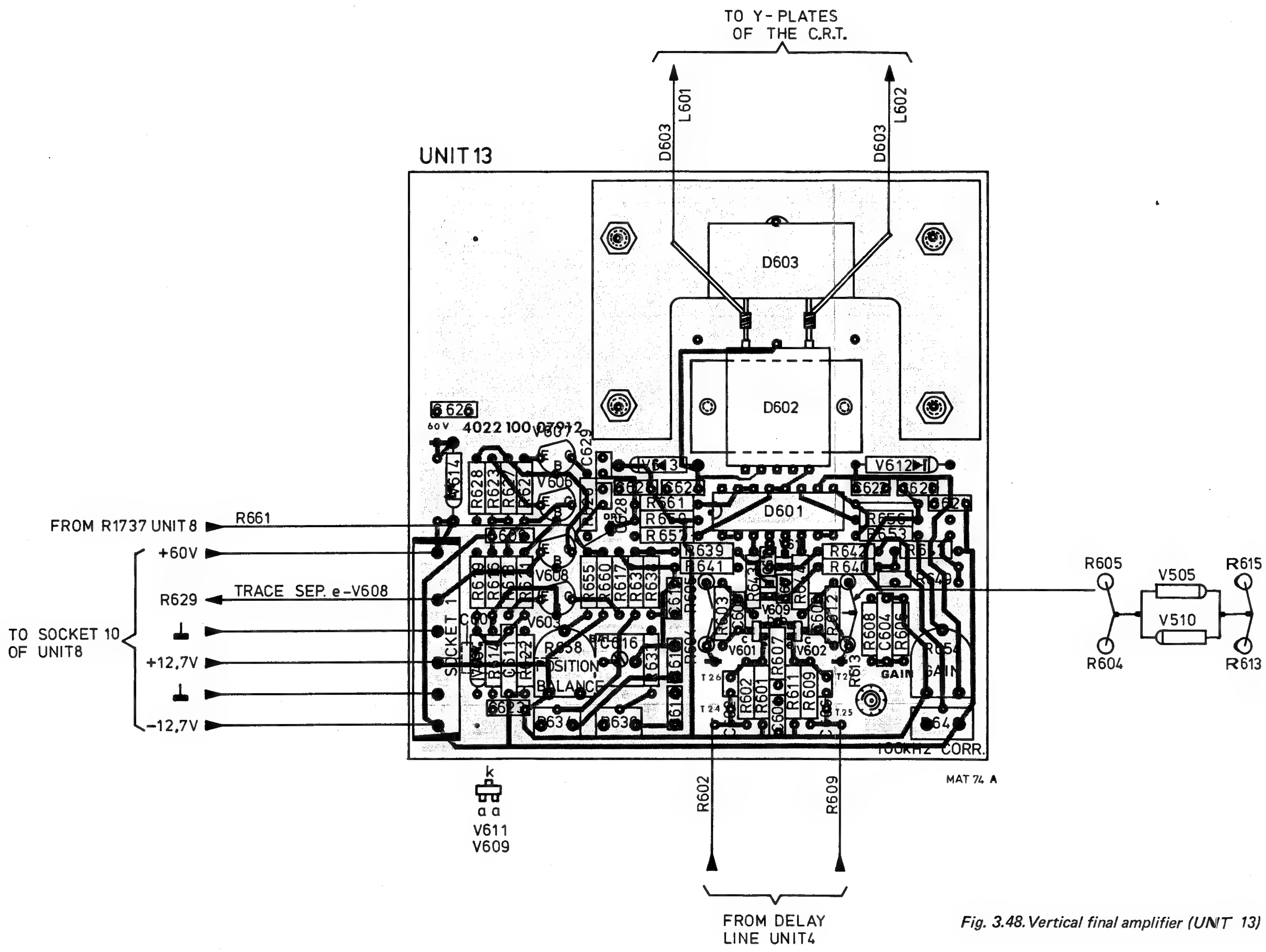


Fig. 3.48. Vertical final amplifier (UNIT 13)

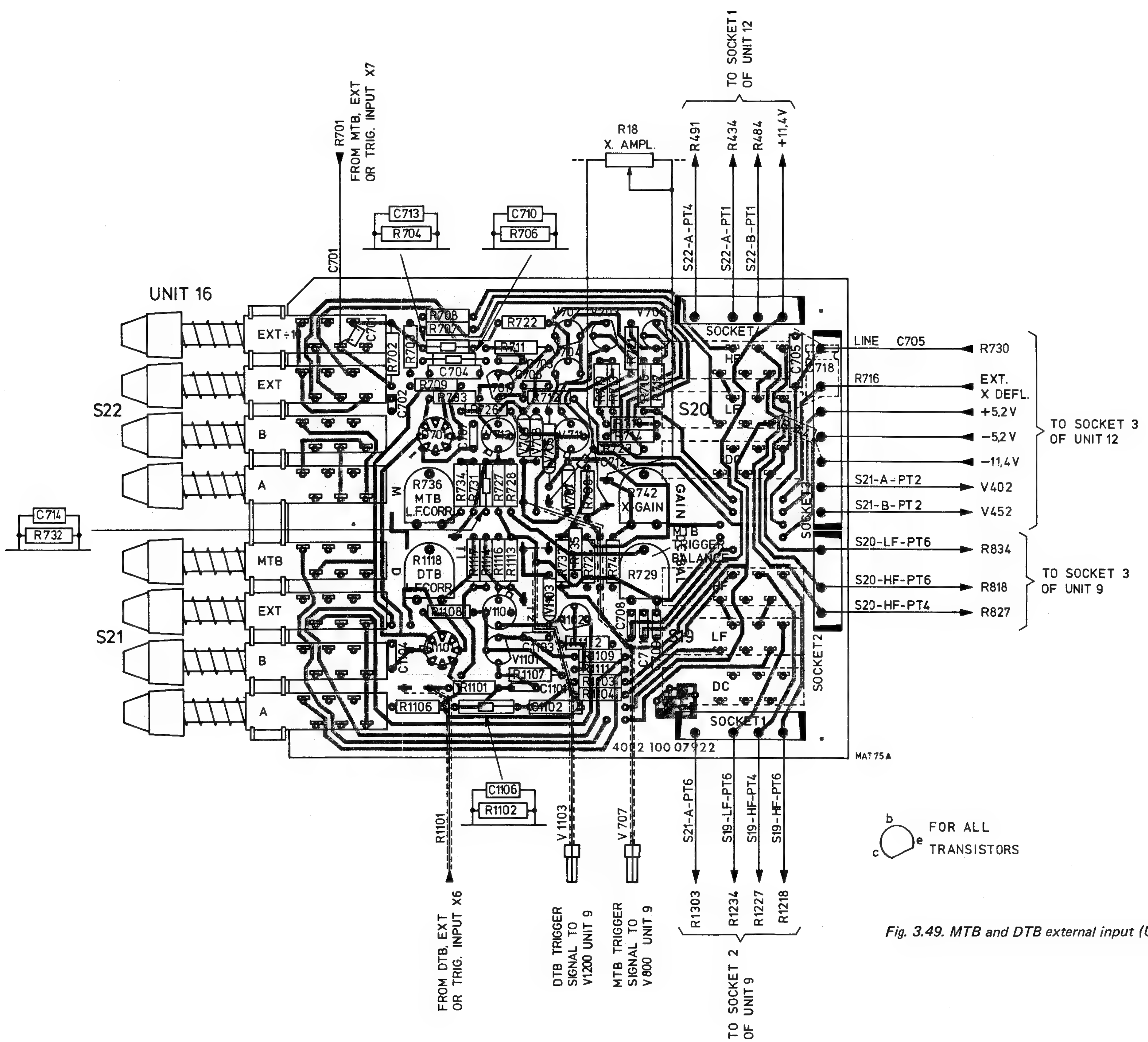


Fig. 3.49. MTB and DTB external input (UNIT 16)

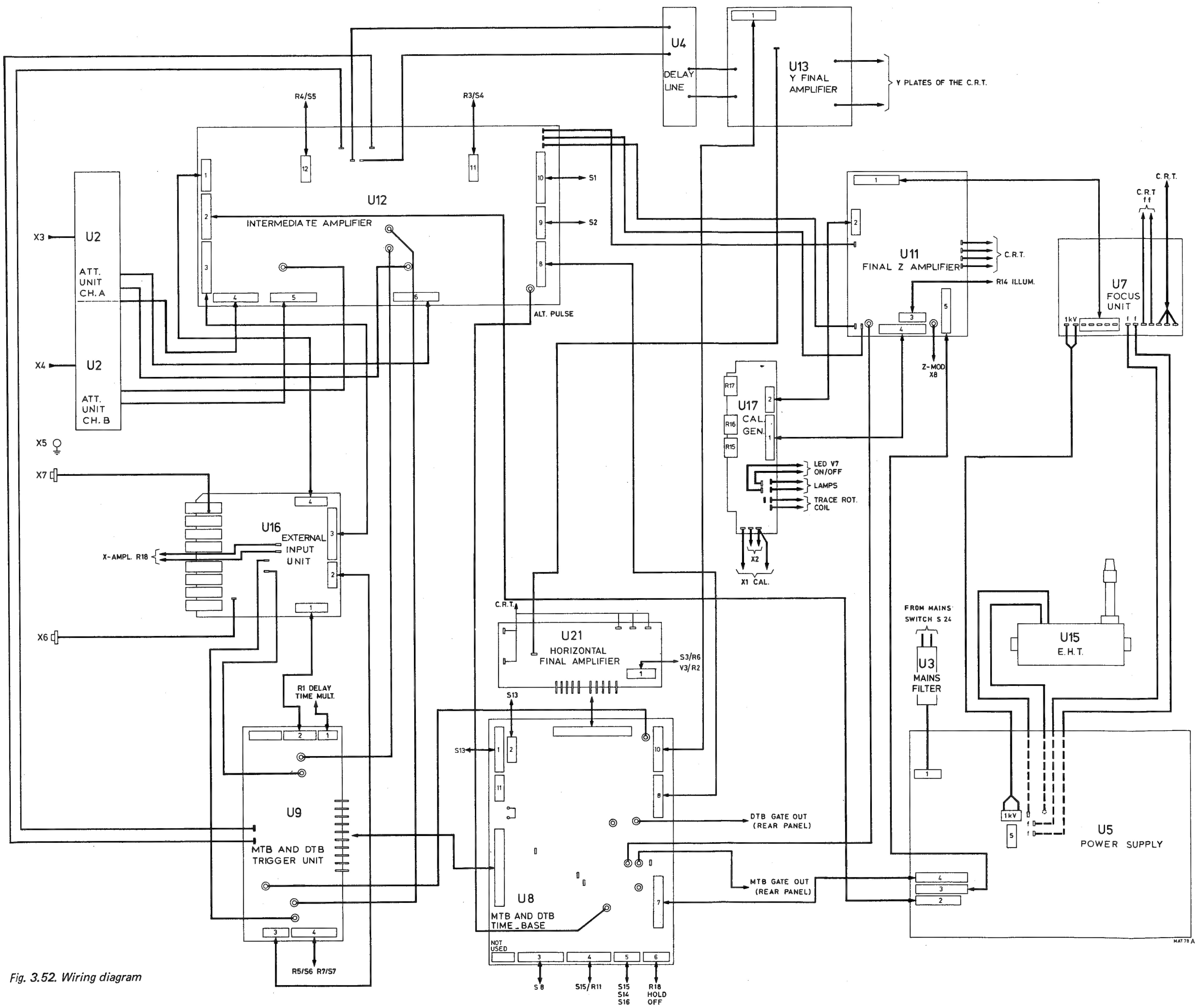
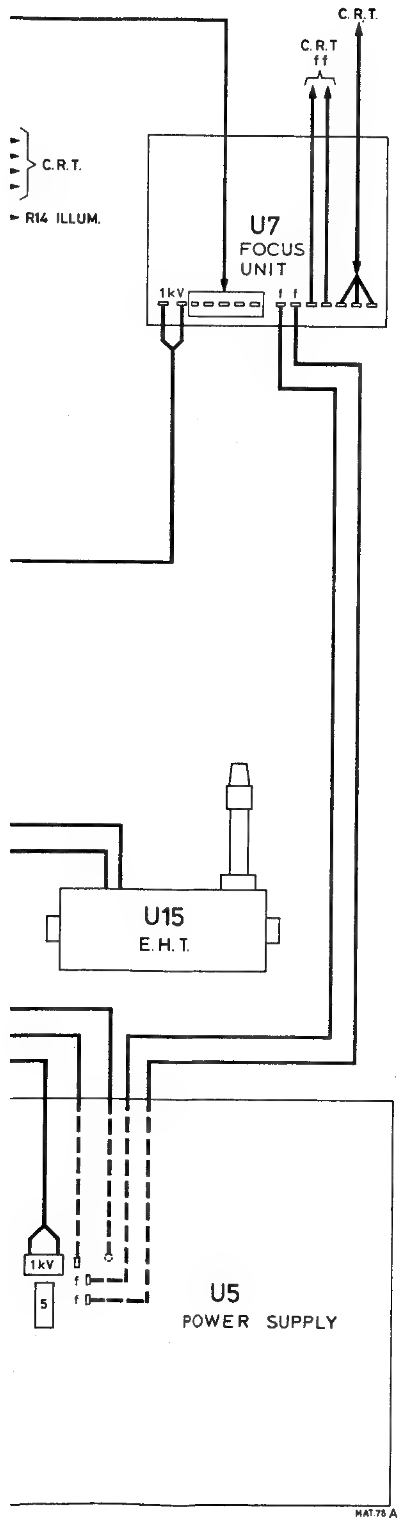
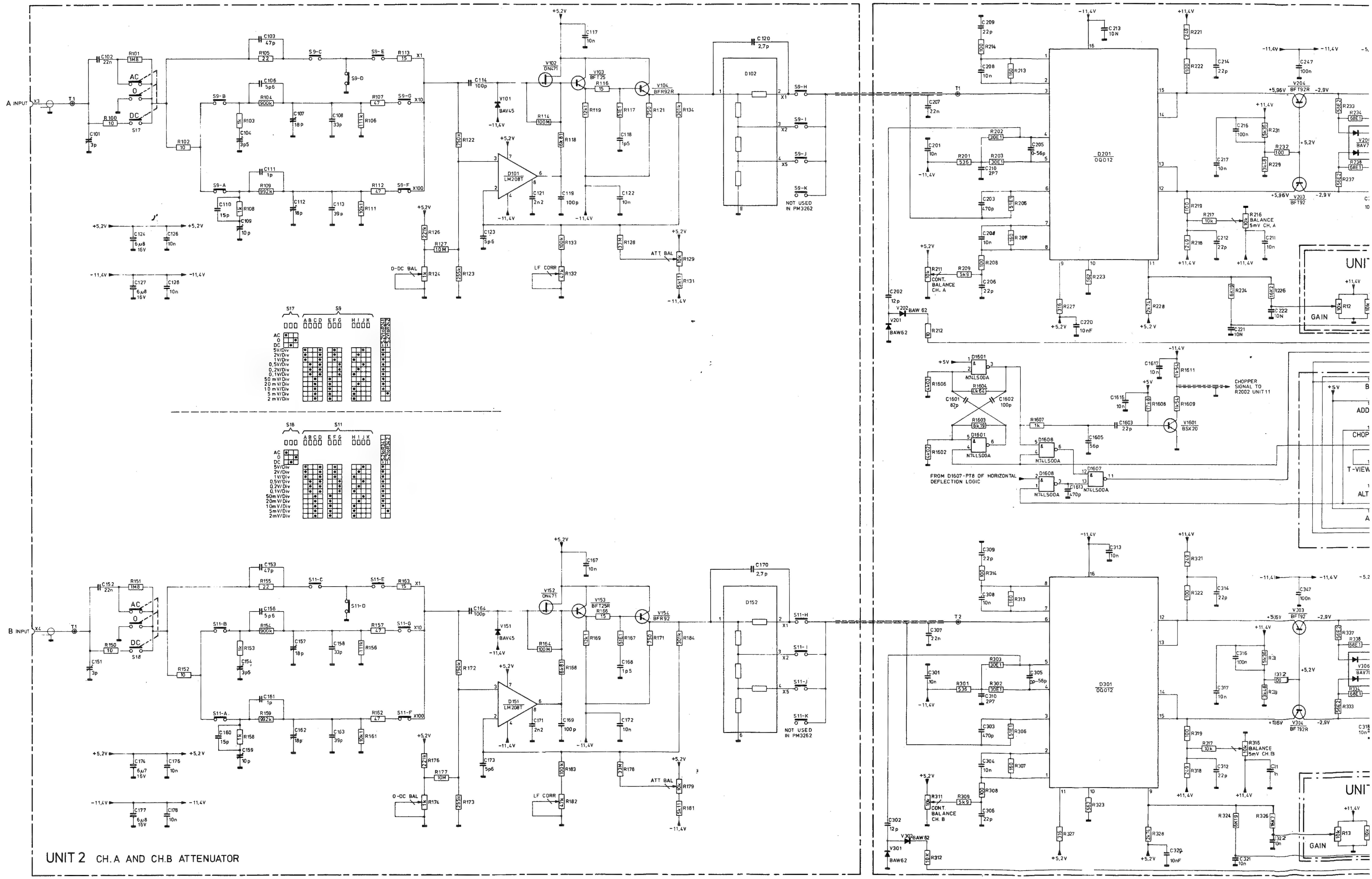


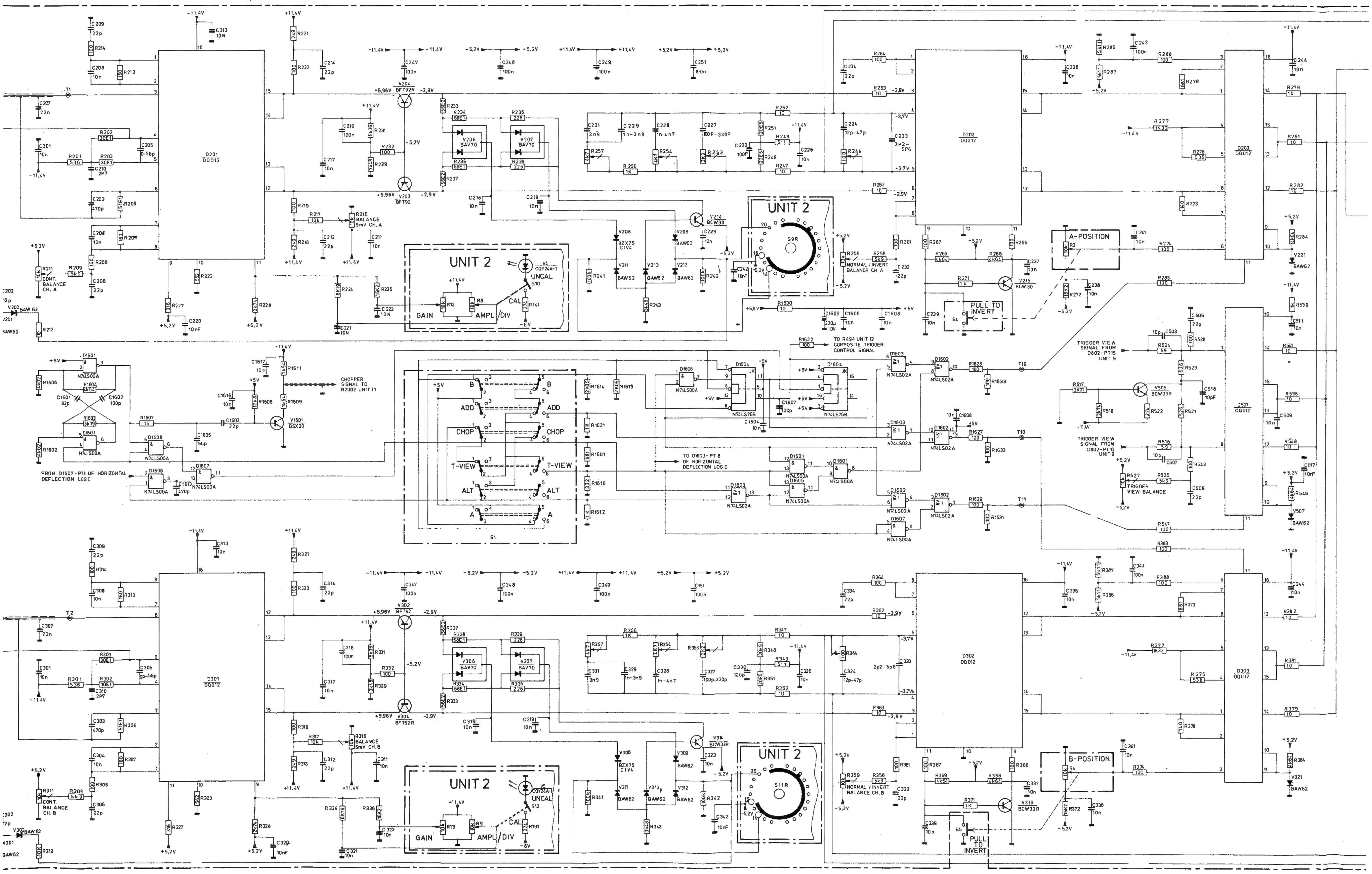
Fig. 3.52. Wiring diagram

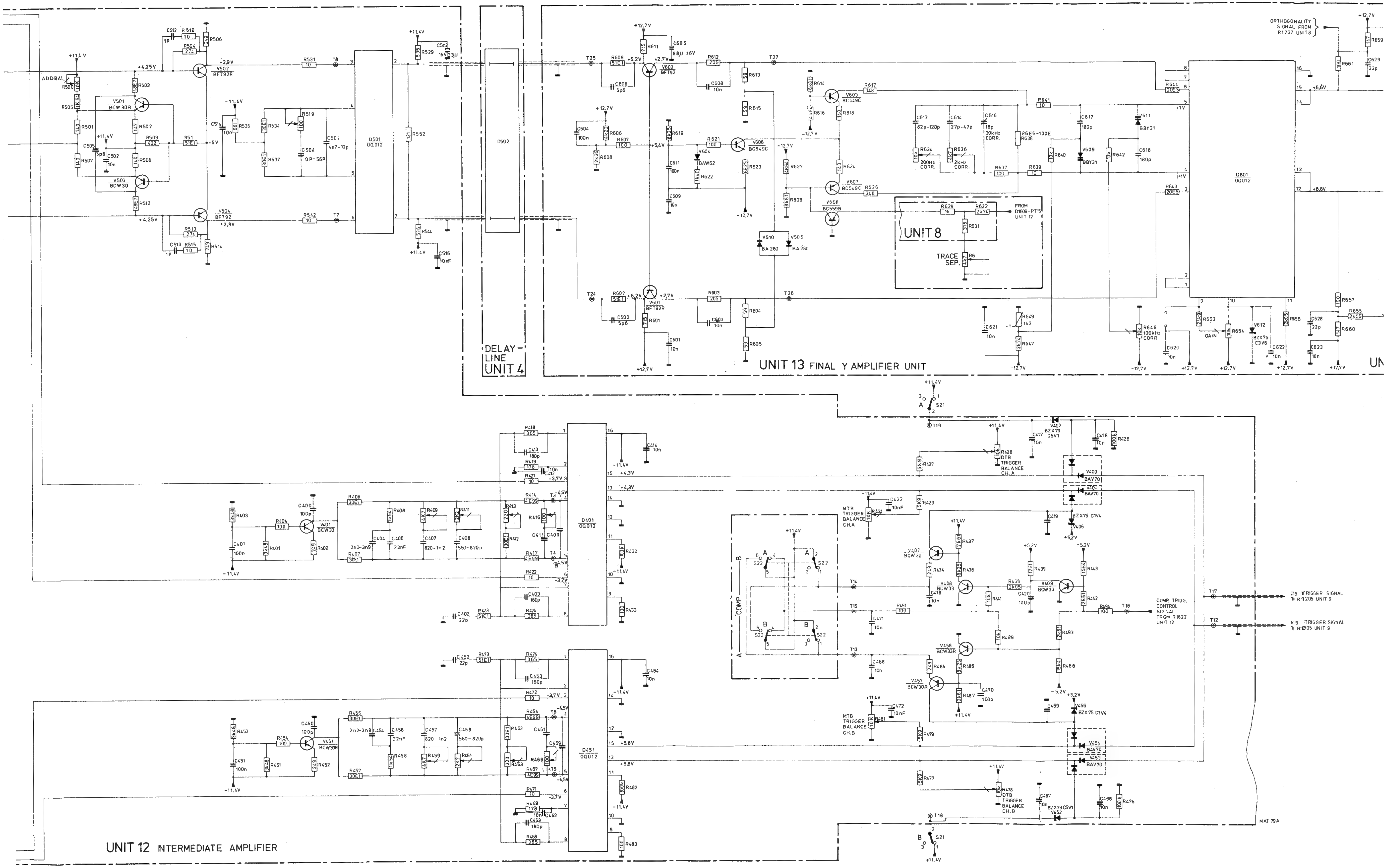


C.R.T.
C.R.T
f f
C.R.T.
R14 ILLUM.
U7
FOCUS
UNIT
1kV
f f
U15
E.H.T.
1kV
5
f
f
U5
POWER SUPPLY
MAT 78 A



UNIT 2 CH.A AND CH.B ATTENUATOR




DELAY LINE
UNIT 4
UNIT 13 FINAL Y AMPLIFIER UNIT
UNIT 8
TRACE SEP.
FROM D1509-PT15 UNIT 12
ORTHOGONALITY SIGNAL FROM R1737 UNIT 8
UNIT 12 INTERMEDIATE AMPLIFIER
COMP. TRIGG. CONTROL SIGNAL FROM R1622 UNIT 12
DTB TRIGGER SIGNAL TI R1205 UNIT 9
MTB TRIGGER SIGNAL TI R1805 UNIT 9
MTB TRIGGER BALANCE CH.A
MTB TRIGGER BALANCE CH.B
DTB TRIGGER BALANCE CH. A
DTB TRIGGER BALANCE CH. B
COMP.
MAT 79A

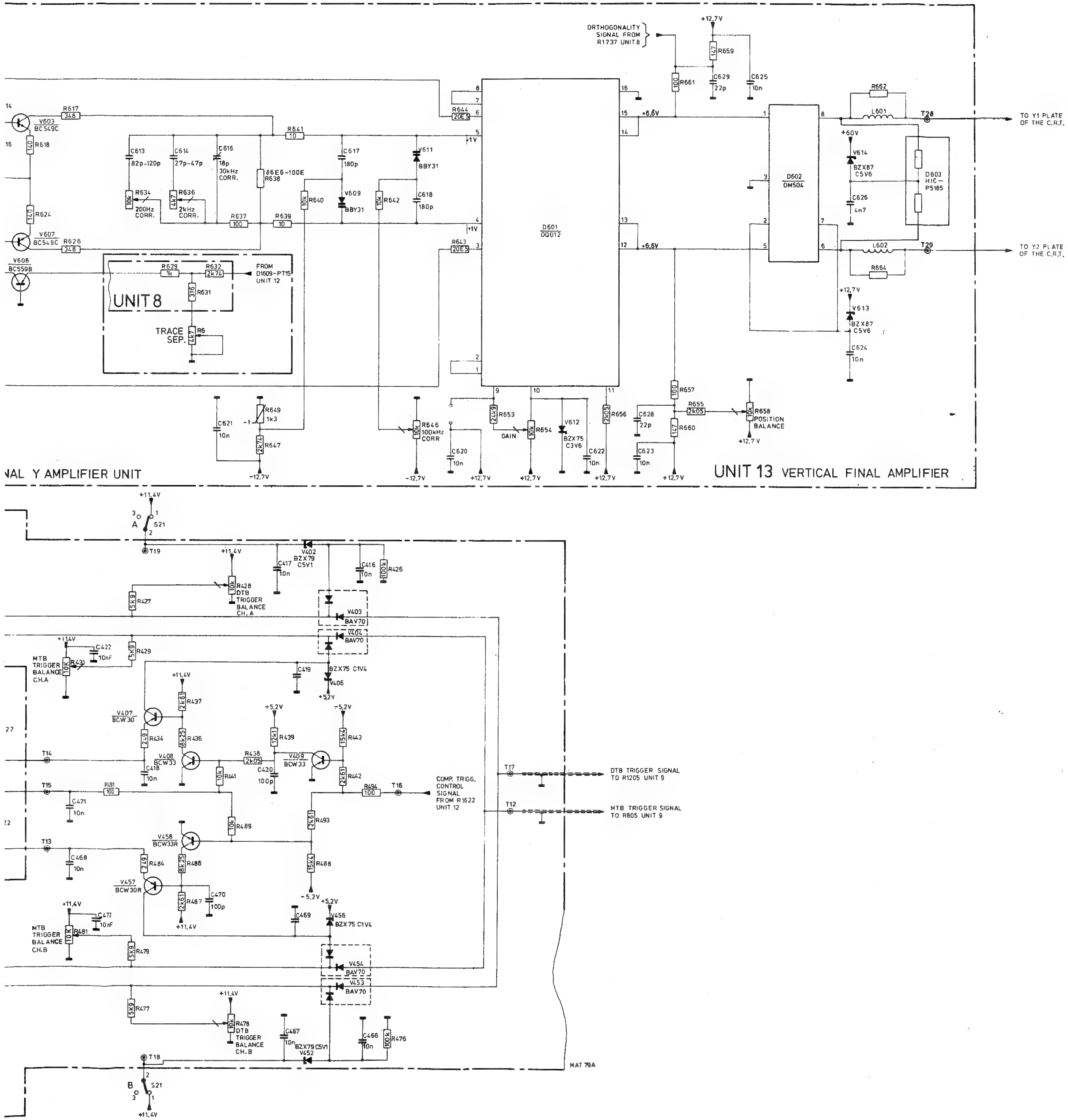
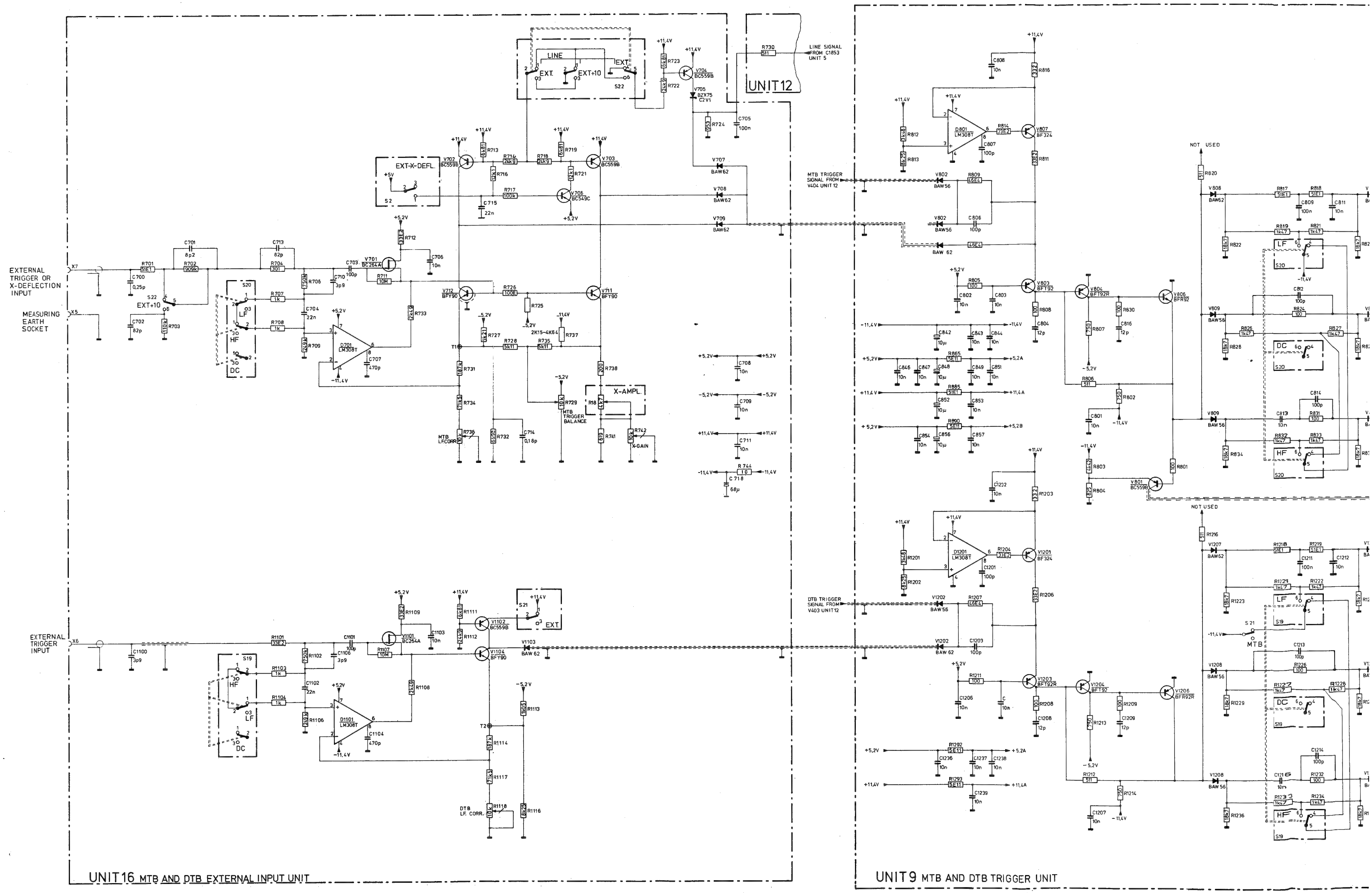
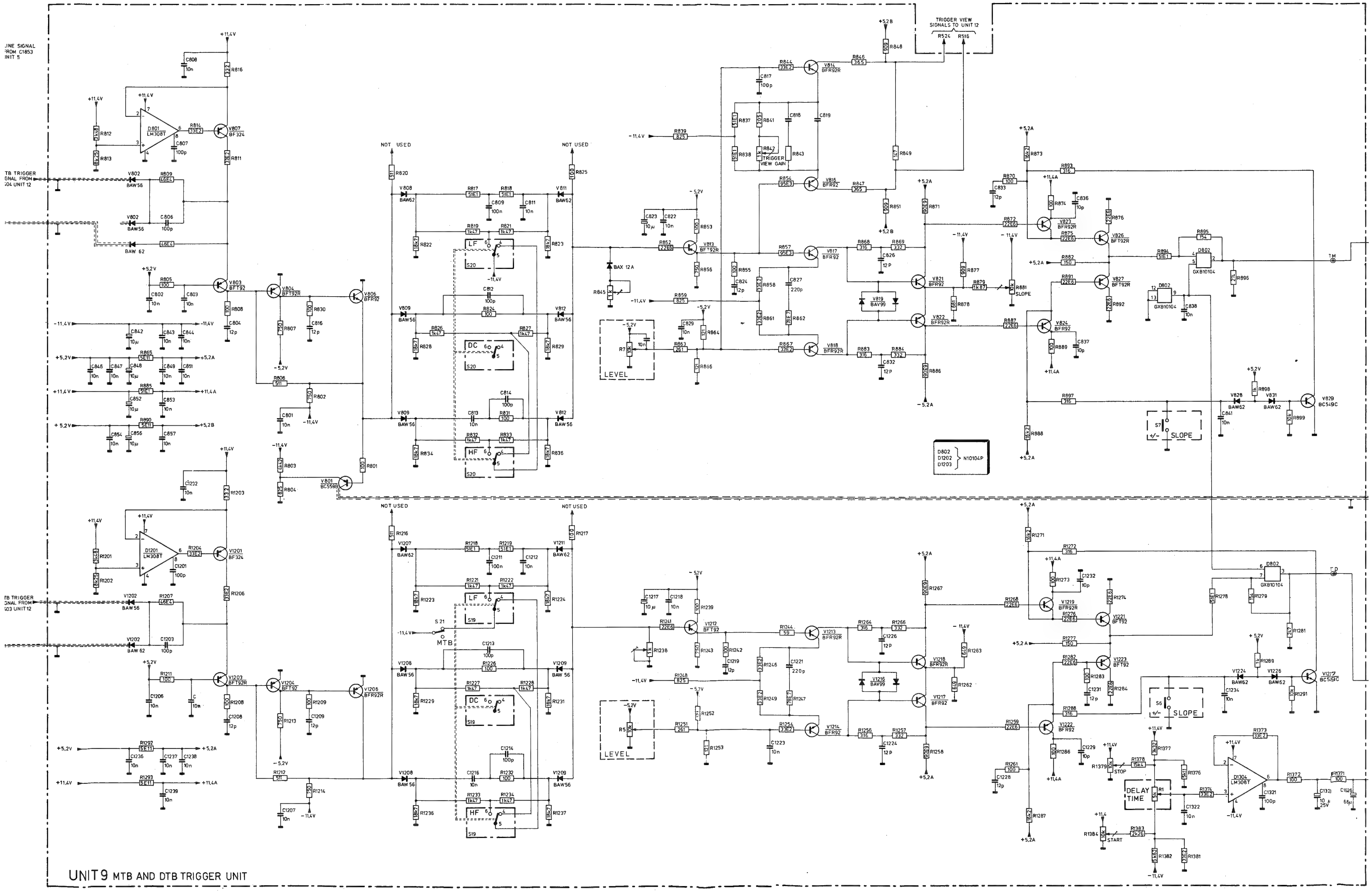
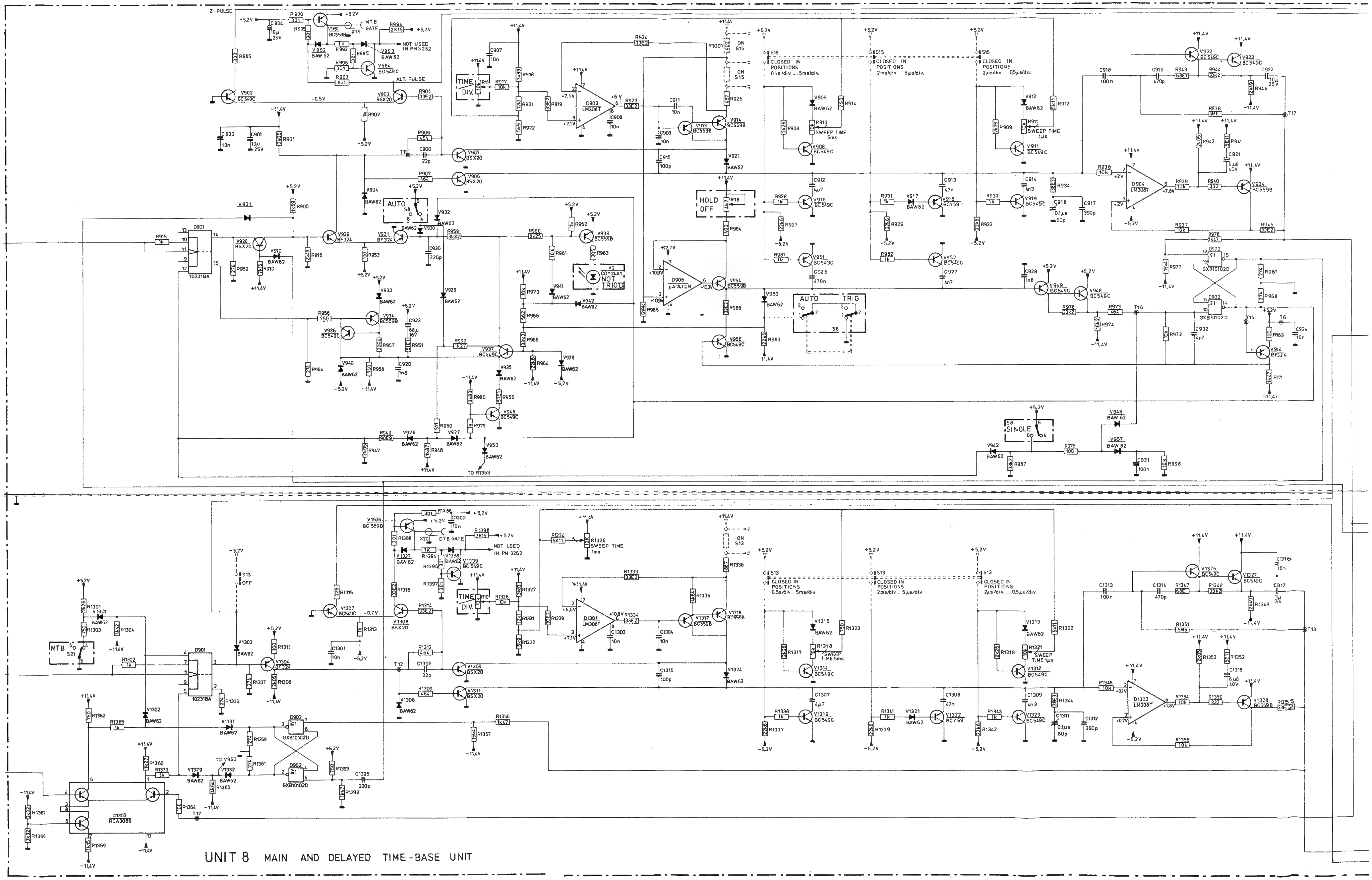


Fig. 3.53. Circuit diagram of the vertical amplifiers

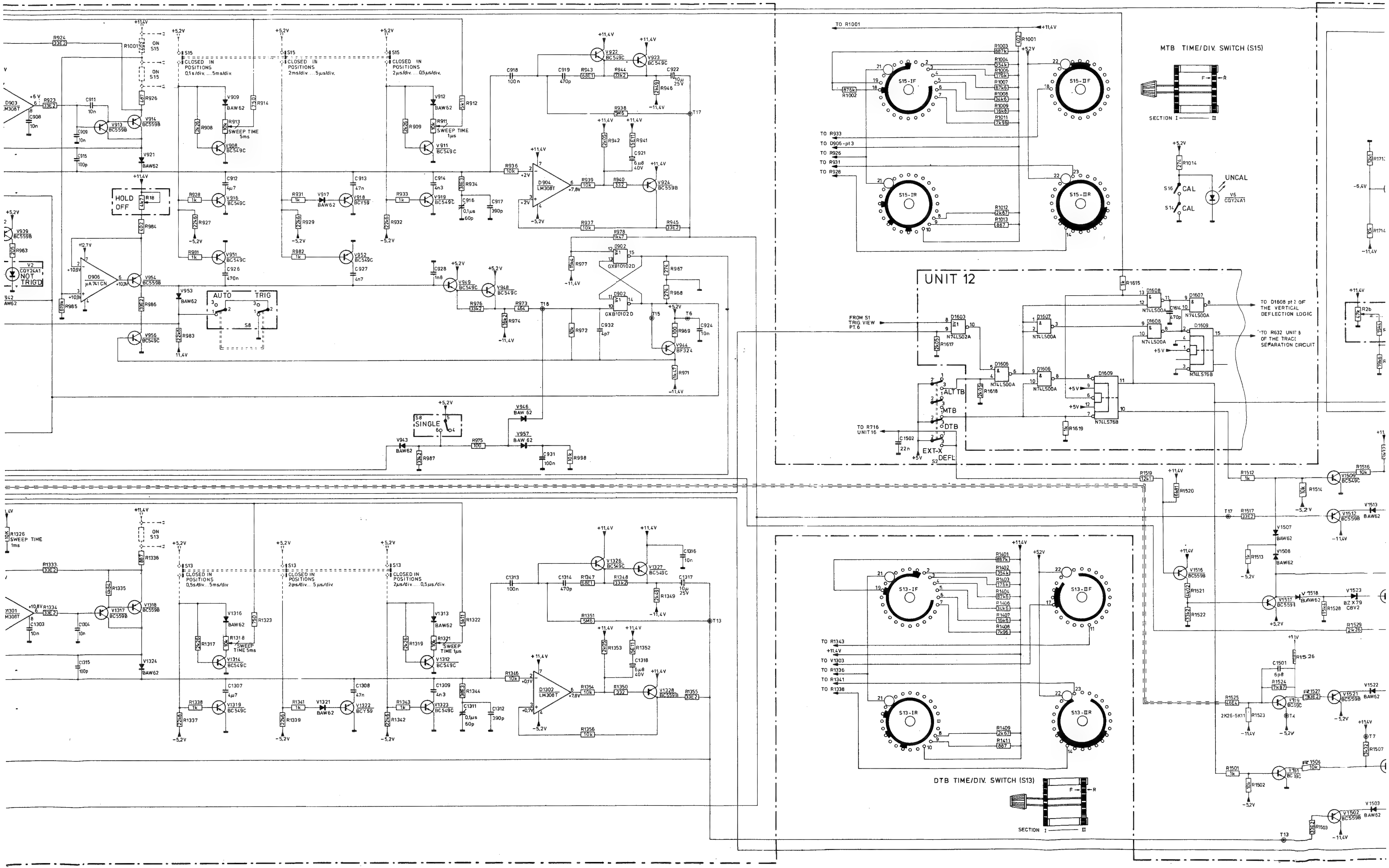

EXTERNAL TRIGGER OR X-DEFLECTION INPUT
MEASURING EARTH SOCKET
EXTERNAL TRIGGER INPUT
EXT-X-DEFL.
LINE
EXT.
EXT÷10
S22
LINE SIGNAL FROM C1853 UNIT 5
UNIT12
X-AMPL.
MTB TRIGGER BALANCE
MTB LF.CORR.
X-GAIN
DTB LF. CORR.
EXT
MTB TRIGGER SIGNAL FROM V404 UNIT 12
DTB TRIGGER SIGNAL FROM V403 UNIT12
NOT USED
MTB
UNIT16 MTB AND DTB EXTERNAL INPUT UNIT
UNIT9 MTB AND DTB TRIGGER UNIT



UNIT 9 MTB AND DTB TRIGGER UNIT



UNIT 8 MAIN AND DELAYED TIME-BASE UNIT


UNIT 12
MTB TIME/DIV. SWITCH (S15)
DTB TIME/DIV. SWITCH (S13)
SECTION I — II
HOLD OFF
AUTO TRIG
SINGLE
UNCAL
CAL
NOT TRIG'D
ALT TB
MTB
DTB
EXT-X DEFL
TO D1608 pt 2 OF THE VERTICAL DEFLECTION LOGIC
TO R632 UNIT 8 OF THE TRACE SEPARATION CIRCUIT
FROM S1 TRIG VIEW PT.6
TO R716 UNIT 16
TO R1001
TO R933
TO D905-pt 3
TO R926
TO R931
TO R928
TO R1343
TO V1303
TO R1336
TO R1341
TO R1338

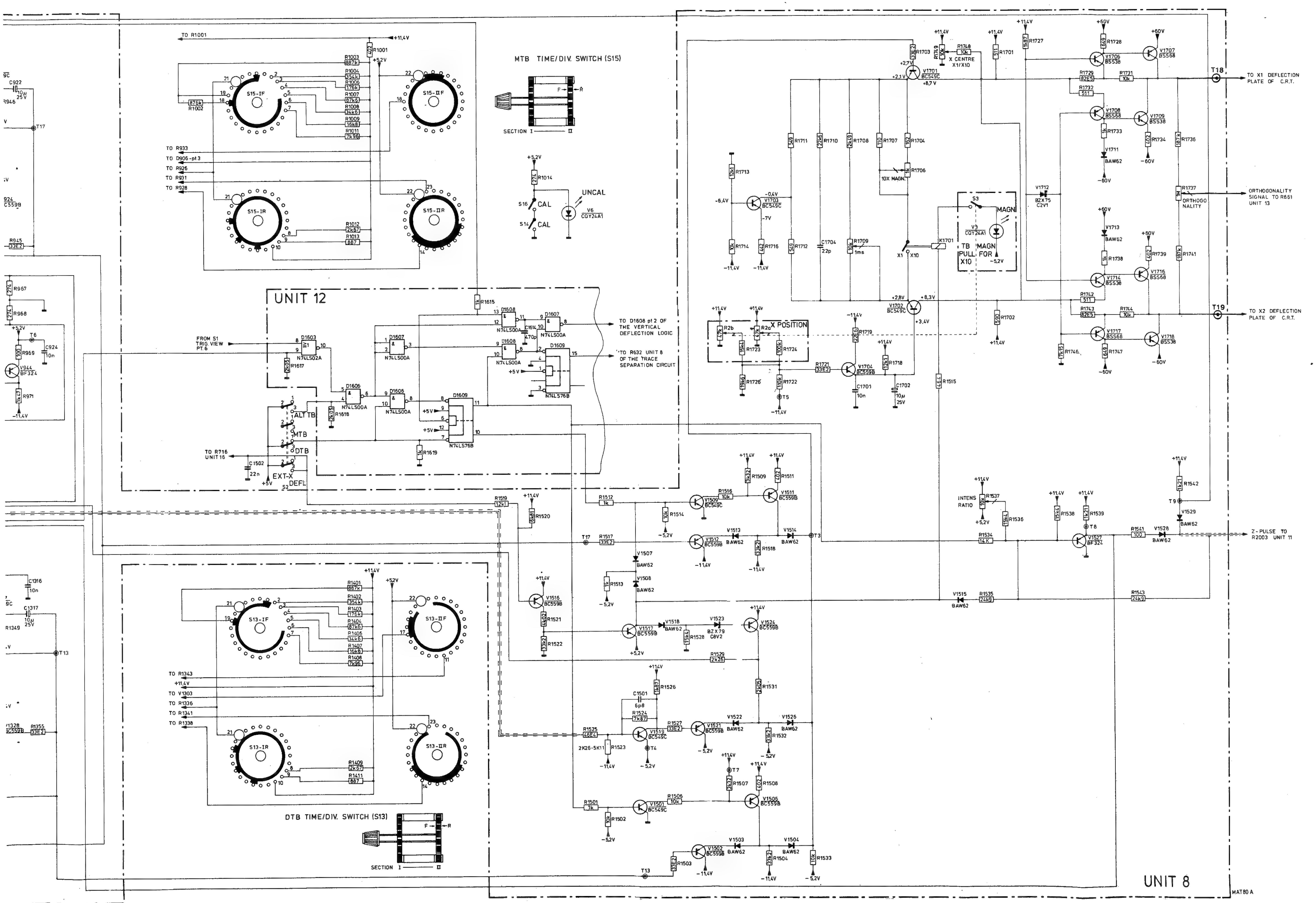
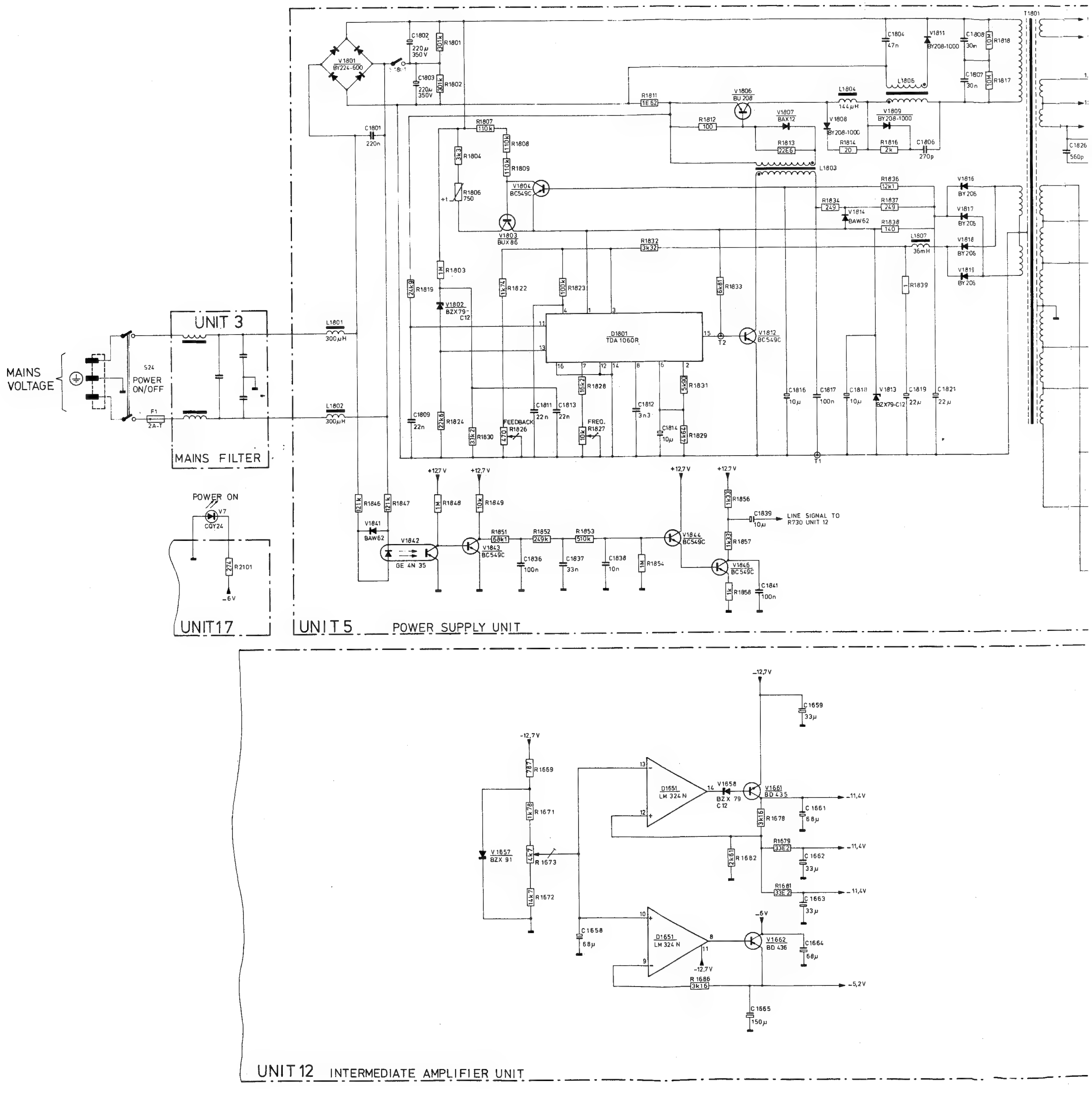
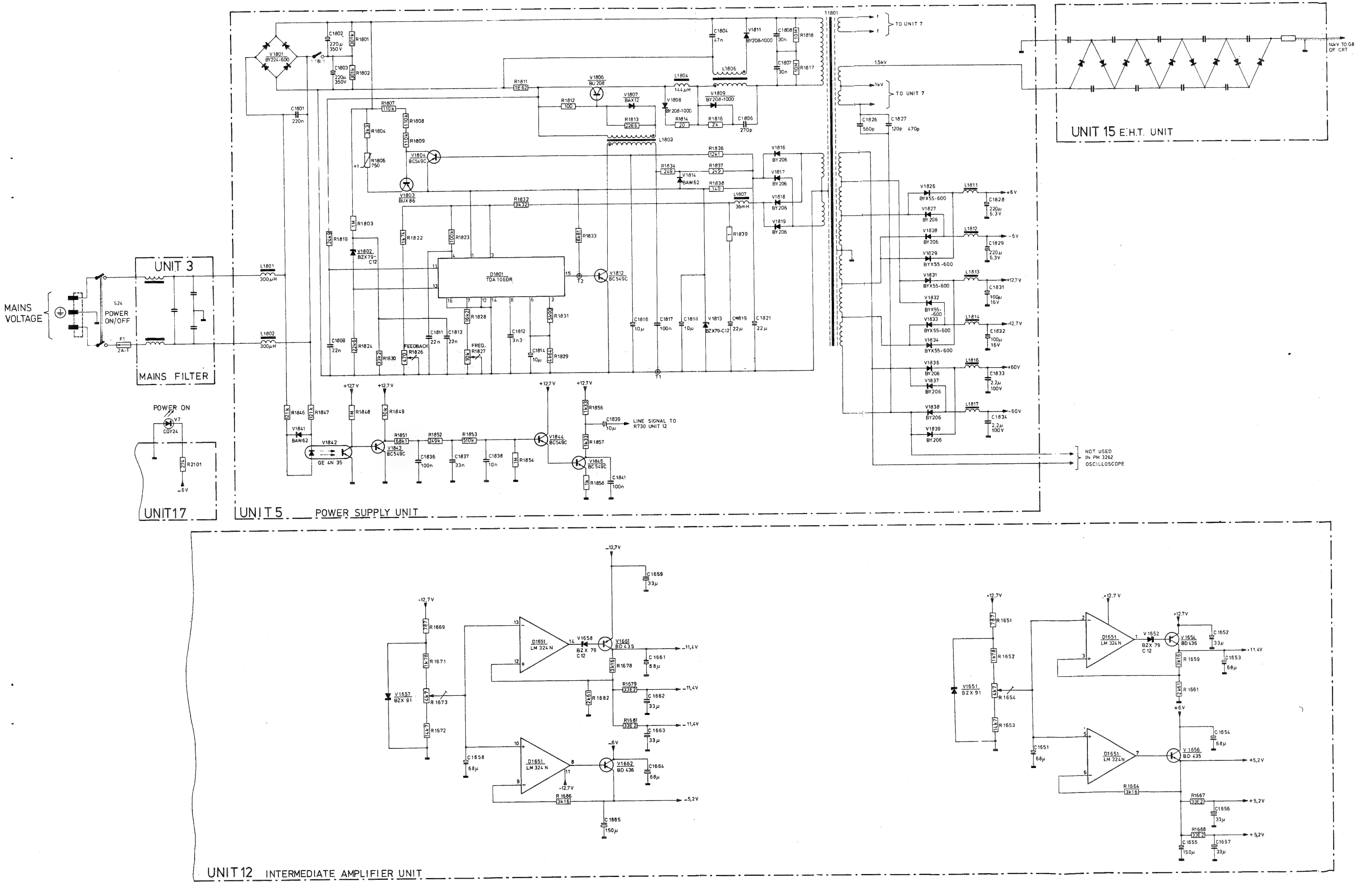


Fig. 3.54. Circuit diagram of the main and delayed time-bases


MAINS VOLTAGE
S24 POWER ON/OFF
F1 2A-T
UNIT 3
MAINS FILTER
POWER ON
V7 CQY24
R2101
UNIT17
L1801 300μH
L1802 300μH
V1801 BY224-600
C1802 220μ 350V
C1803 220μ 350V
R1801
R1802
C1801 220n
R1807 110k
R1808
R1809
R1804
R1806 750
V1804 BC549C
V1803 BUX86
R1803
R1819
V1802 BZX79-C12
R1822
R1823
D1801 TDA 1060R
V1812 BC549C
R1833
R1832 3k32
R1811 1E82
R1812 100
V1806 BU 208
V1807 BAX12
R1813 22E6
L1804 144μH
V1808 BY208-1000
V1809 BY208-1000
R1814 20
R1816 2k
C1806 270p
L1803
L1805
C1804 47n
V1811 BY208-1000
C1808 30n
C1807 30n
R1818
R1817
T1801
C1826 560p
R1836 12k1
R1837 249
R1834 249
V1814 BAW62
R1838 140
L1807 36mH
R1839
V1816 BY206
V1817 BY206
V1818 BY206
V1815 BY206
C1809 22n
R1824
R1830
FEEDBACK R1826
C1811 22n
C1813 22n
R1828
FREQ. R1827
C1812 3n3
C1814 10μ
R1829
R1831
C1816 10μ
C1817 100n
C1818 10μ
V1813 BZX79-C12
C1819 22μ
C1821 22μ
T1
T2
+12,7V
R1846
R1847
V1841 BAW62
V1842 CE 4N 35
R1848
R1849
R1851 68k1
V1843 BC549C
R1852 249k
R1853 510k
C1836 100n
C1837 33n
C1838 10n
R1854
V1844 BC549C
V1846 BC549C
R1856
R1857
R1858
C1839 10μ
LINE SIGNAL TO R730 UNIT 12
C1841 100n
UNIT 5 POWER SUPPLY UNIT
-12,7V
C1659 33μ
R1669
R1671
V1657 BZX 91
R1673
R1672
D1651 LM 324 N
V1658 BZX 79 C12
V1661 BD 435
R1678
C1661 68μ
-11,4V
R1679 33E2
C1662 33μ
R1682
R1681 33E2
C1663 33μ
C1658 68μ
-6V
V1662 BD 436
C1664 68μ
R1686 3k16
-5,2V
C1665 150μ
UNIT 12 INTERMEDIATE AMPLIFIER UNIT



MAINS VOLTAGE
UNIT 3
MAINS FILTER
S24 POWER ON/OFF
F1 2A-T
POWER ON
V7 CQY24
UNIT17
UNIT 5 POWER SUPPLY UNIT
D1801 TDA 1060R
T1801
TO UNIT 7
1,5kV
1kV
UNIT 15 E.H.T. UNIT
14kV TO G8 OF CRT
GE 4N 35
LINE SIGNAL TO R730 UNIT 12
NOT USED IN PM 3262 OSCILLOSCOPE
FEEDBACK
FREQ.
+5V
-5V
+12,7V
-12,7V
+60V
-60V
UNIT 12 INTERMEDIATE AMPLIFIER UNIT
D1651 LM 324 N
-11,4V
-5,2V
+11,4V
+5,2V

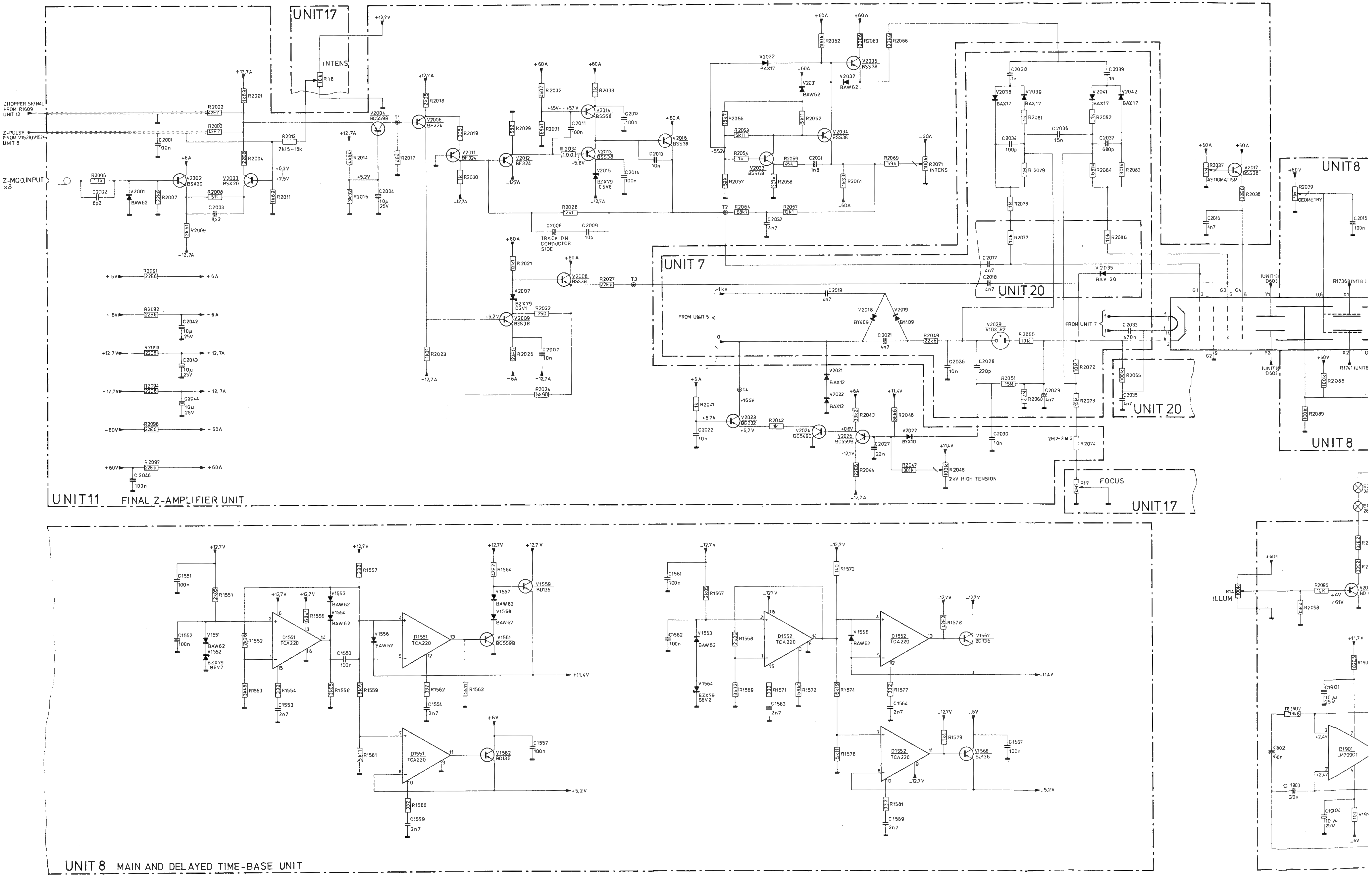


Fig. 1.55. Circuit diagra

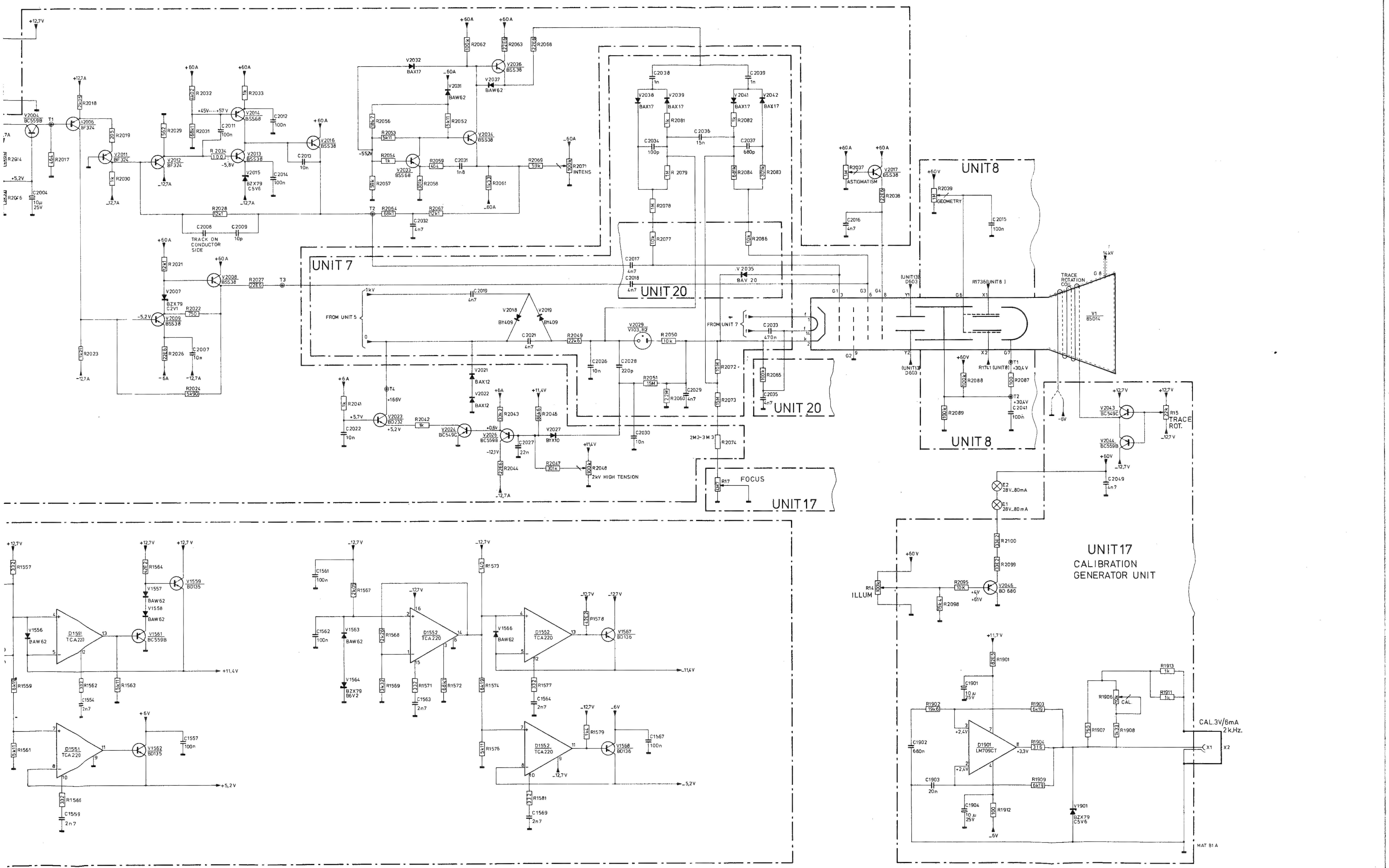


Fig. 3.55. Circuit diagram of power supply, Z-amplifier and C.R.T. circuit

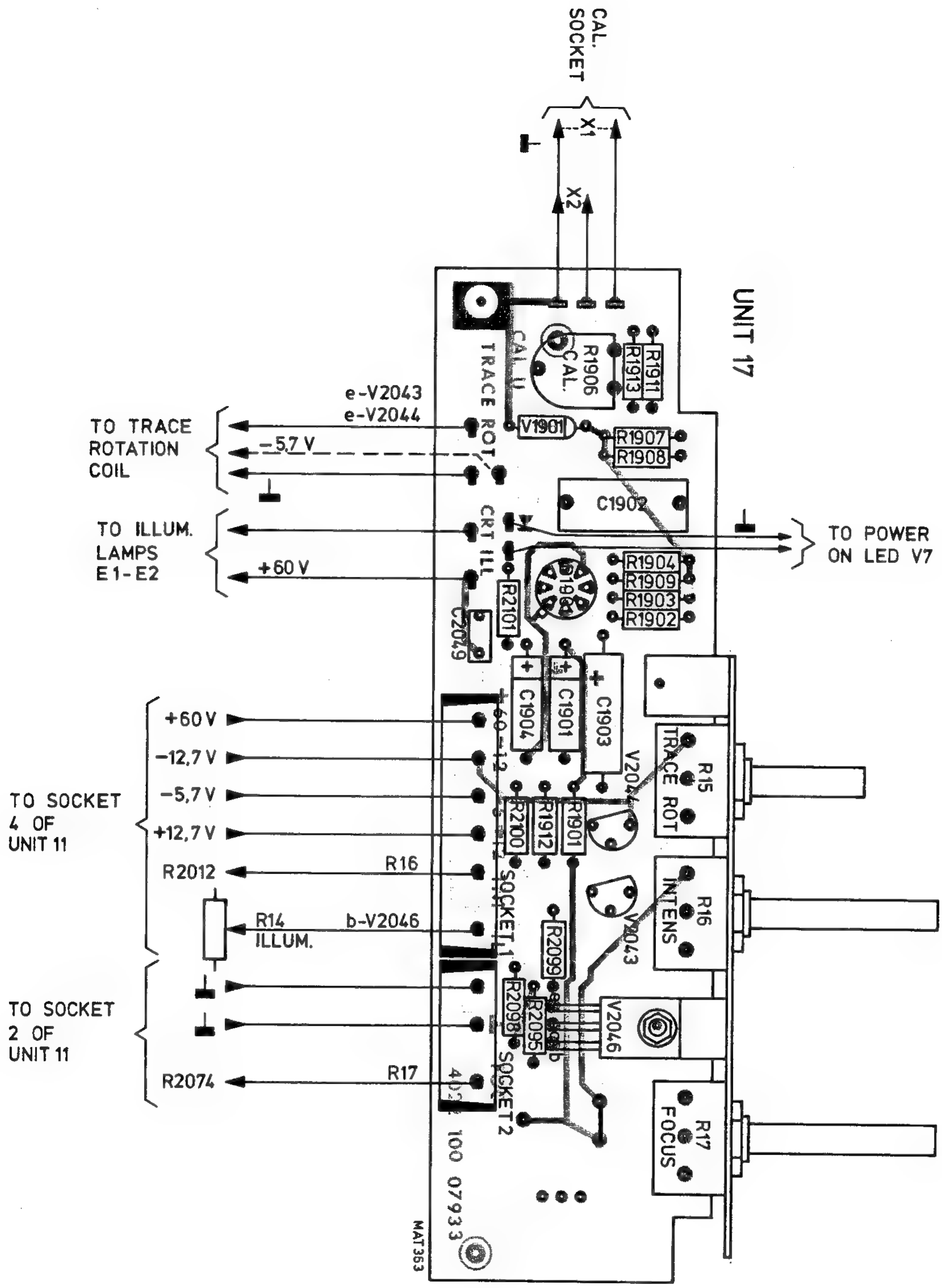


Fig. 3.50. Calibration generator (UNIT 17)

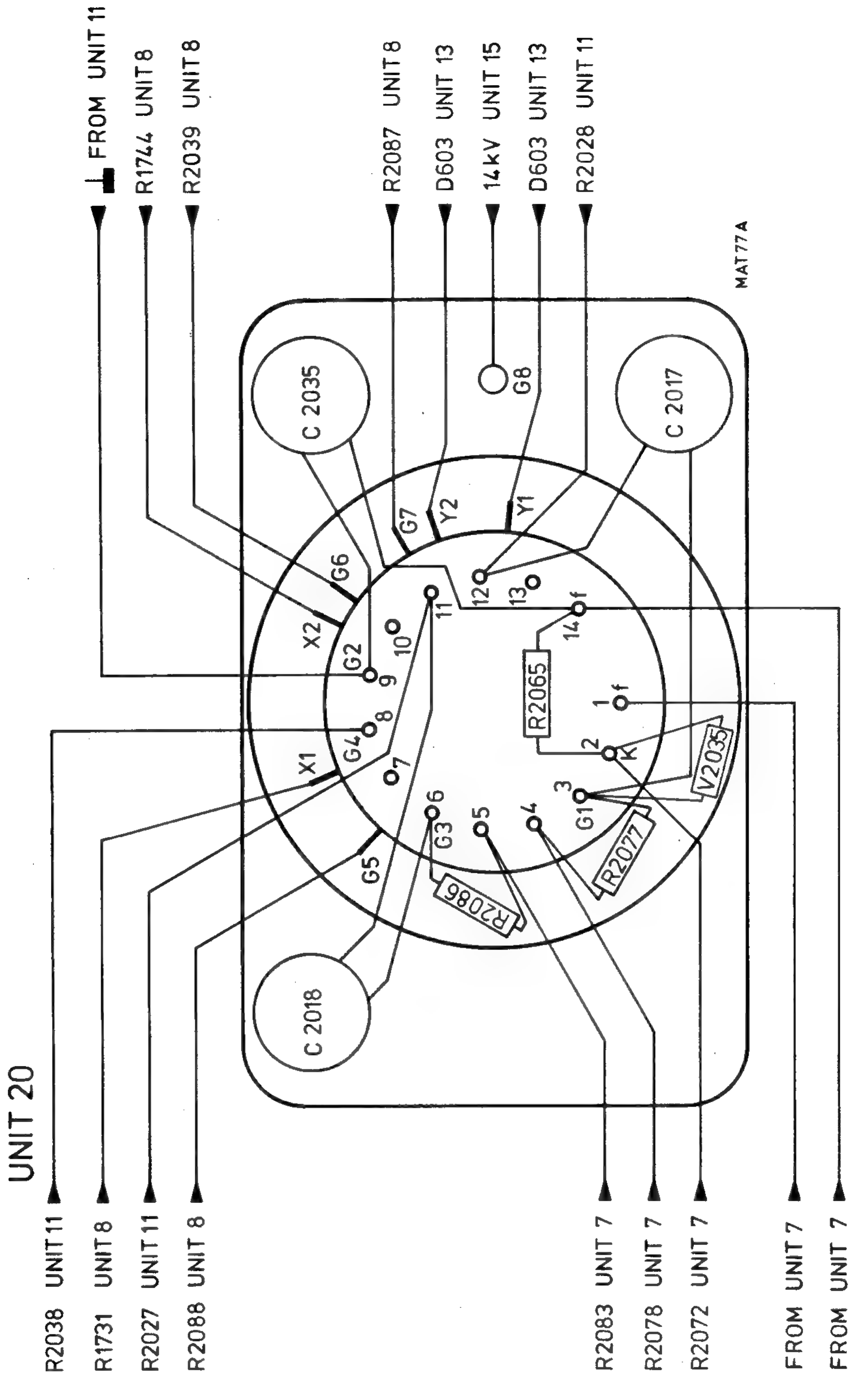


Fig. 3.51 C.R.T. unit (UNIT 20)

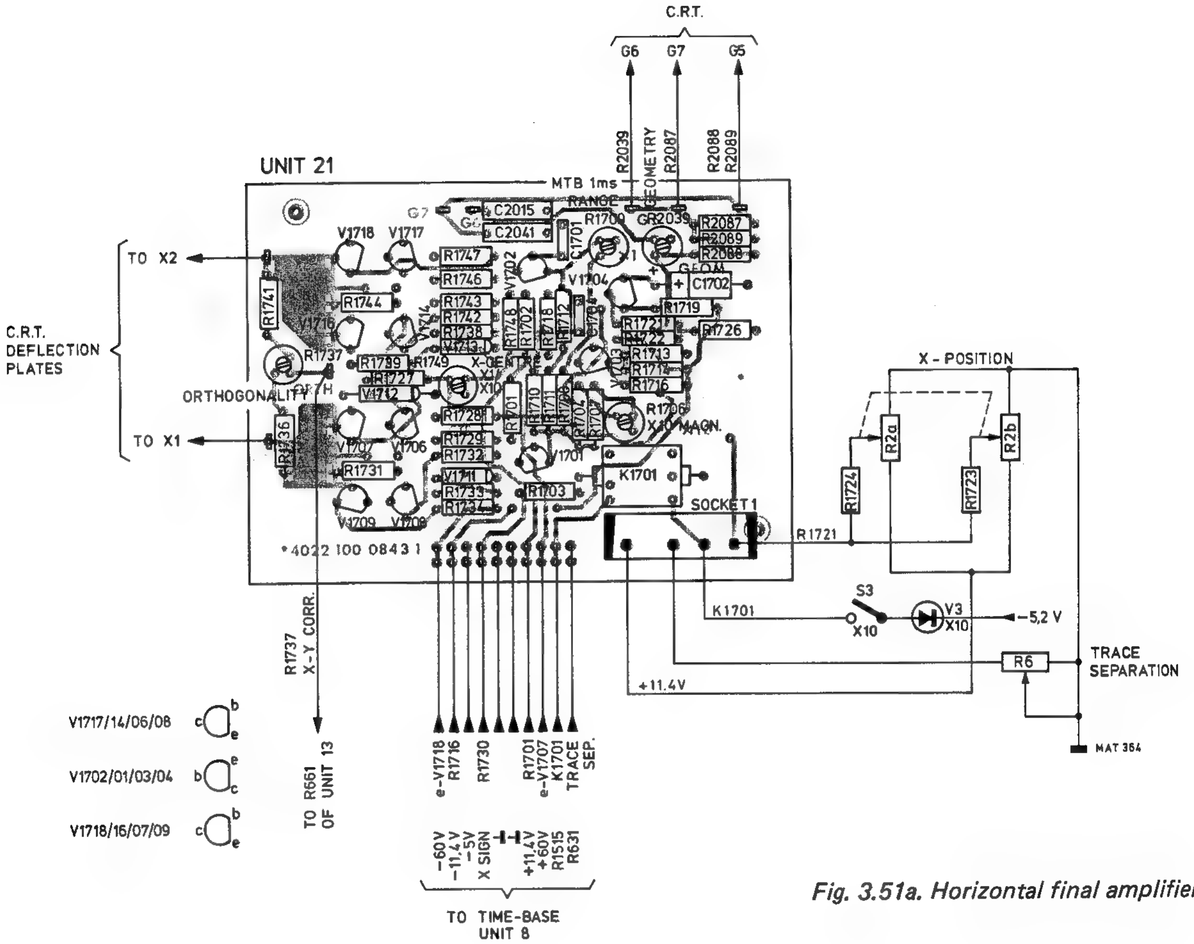


Fig. 3.51a. Horizontal final amplifier

The d.c. voltage levels and waveforms at the relevant points in the circuit diagrams are measured with the following control settings:

- Push the Y POSITION controls to NORM position (S4 and S5)
- Set the switches of the channel A and B signal-coupling control to DC (S17 and S18)
- Depress push-button A of the display-mode controls (S1)
- Set the channel A and B AMPL/DIV switch to 1V/DIV and the verniers to CAL
- Set the DELAY TIME control (R1) to 0
- Depress push-button MAIN TB of the X deflection controls (S2)
- Push the TB MAGN control to position 1x
- Depress push-button AUTO of the trigger mode controls (S8)
- Set the m.t.b. TIME/DIV switch to 20 μ sec./DIV.
- Set the d.t.b. TIME/DIV switch to OFF
- Set the m.t.b. and d.t.b. TIME/DIV verniers to CAL
- Depress the push-button DC of the m.t.b. and d.t.b. trigger-coupling controls (S20 and S19)
- Depress the push-buttons A of the m.t.b. and d.t.b. trigger-source controls (S22 and S21)
- Apply a square-wave of 6Vp-p frequency 10kHz to the input sockets of channel A and B (X3 and X4)
- Set the signal in the middle of the screen with the POSITION controls

Required test equipment:

Digital multimeter	e.g. Philips PM2527
Oscilloscope 50 MHz	e.g. Philips PM3240
Function generator	e.g. Philips PM5127

The oscilloscope for measuring the wave-forms has the following control settings:

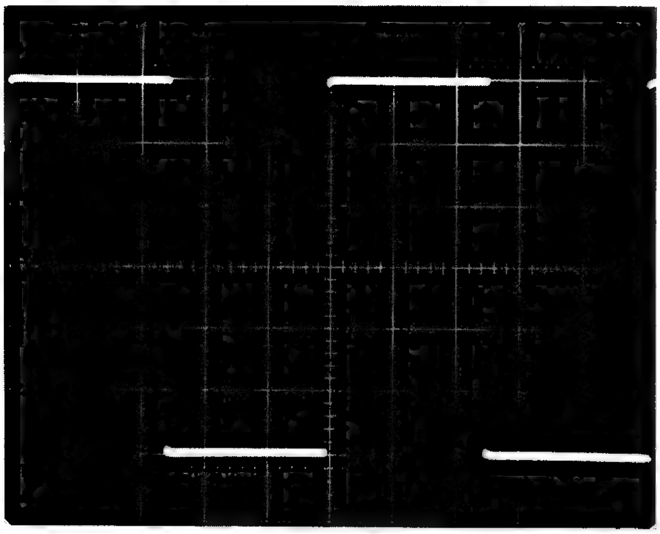
- AC input signal coupling unless otherwise stated.
- Triggered on the positive going slope of the input signal.

Wave forms are measured with a 10 : 1 attenuator.

UNIT 12

T1

0,1 V/DIV. 20μs/DIV.



0

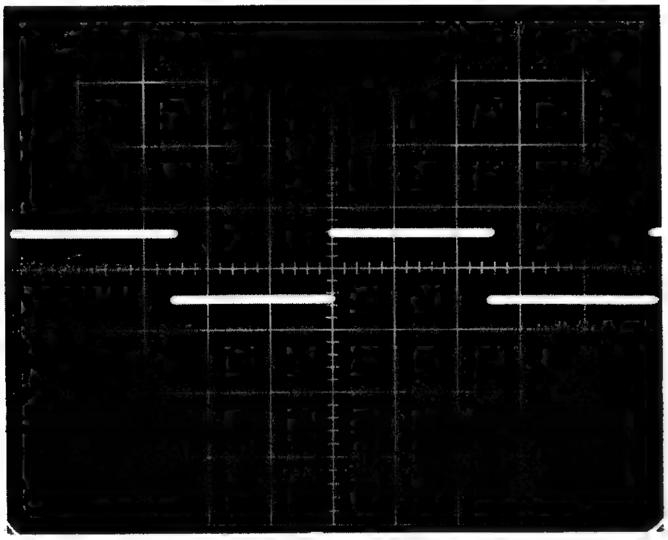
Input signal of channel A and B.
(measured DC coupled).

UNIT 12

T1

T2

5 mV/DIV. 20μs/DIV.



0

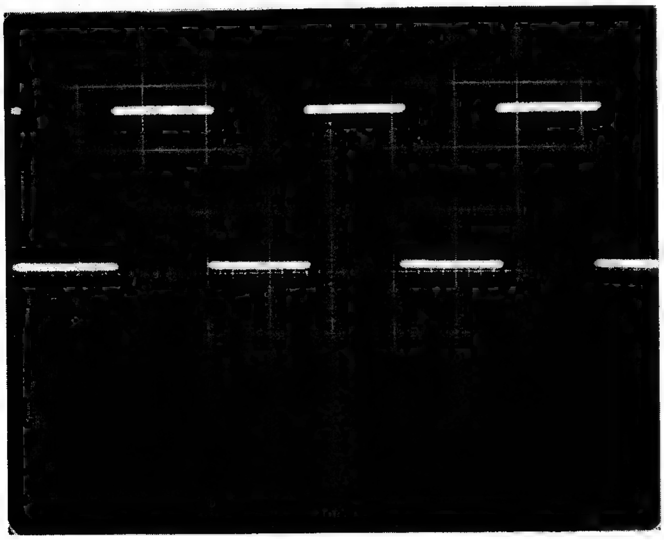
Channel A and B.
(measured DC coupled).

UNIT 12

T9

T10

50 mV/DIV. 0,2ms/DIV.



0

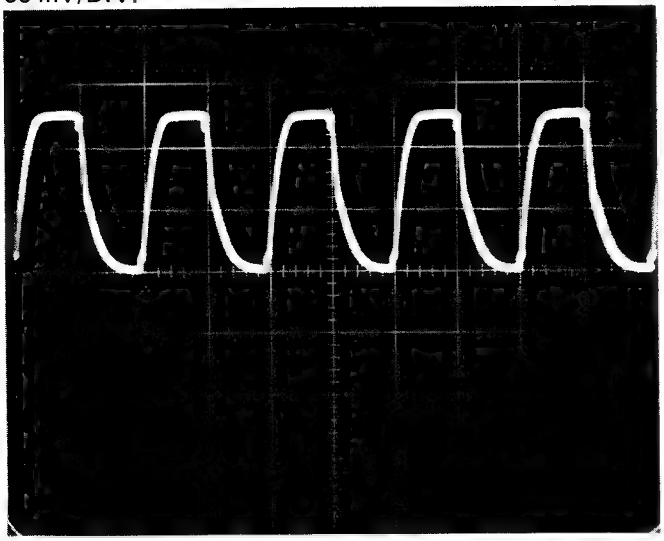
Push-button ALT of S1 depressed.
(measured DC coupled).

UNIT 12

T9

T10

50 mV/DIV. 0,5μs/DIV.



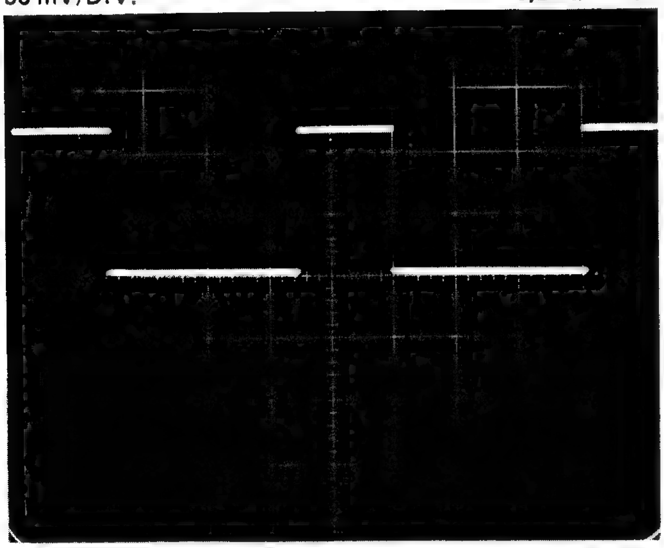
0

Push-button CHOP of S1 depressed.
(measured DC coupled).

UNIT 12

T11

50 mV/DIV. 0,2ms/DIV.



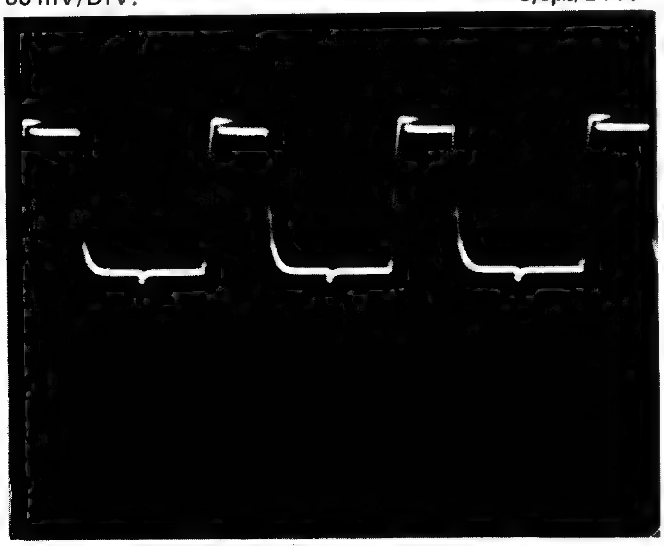
0

Push-buttons ALT and TRIG VIEW of S1 simultaneously depressed.
(measured DC coupled).

UNIT 12

T11

50 mV/DIV. 0,5μs/DIV.



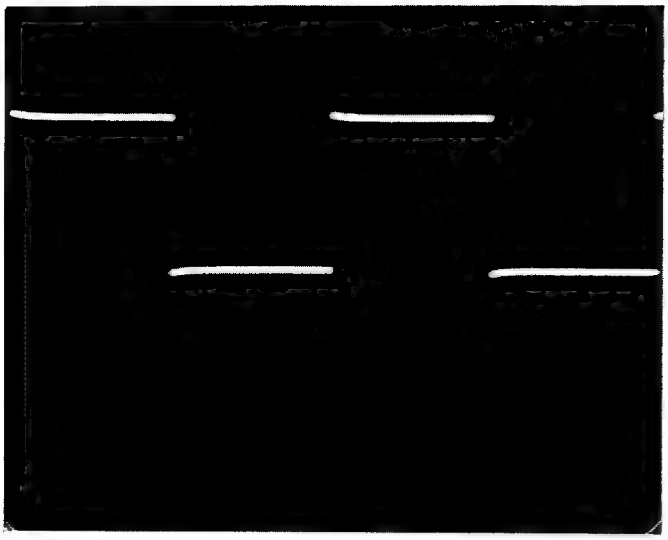
0

Push-buttons CHOP and TRIG VIEW of S1 simultaneously depressed.
(measured DC coupled).

UNIT 12

T7

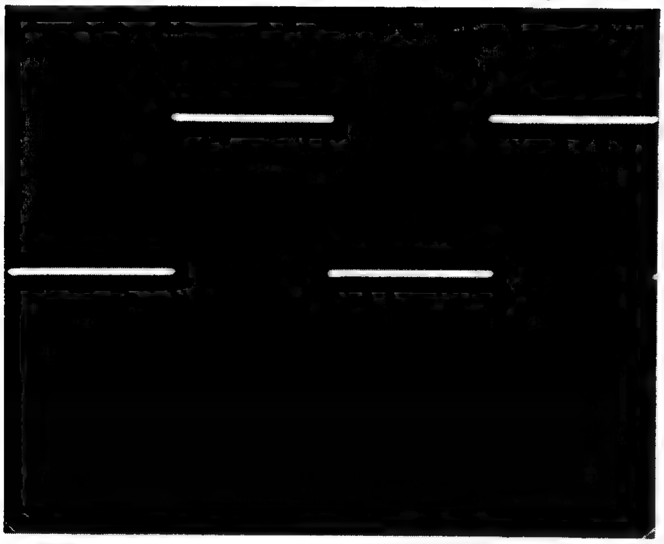
10 mV/DIV. 20μs/DIV.



UNIT 12

T8

10 mV/DIV. 20μs/DIV.

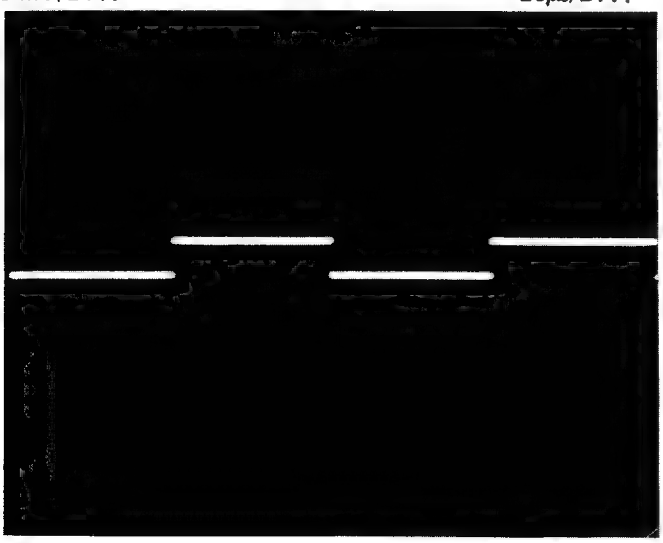


UNIT 12

T3

T5

5 mV/DIV. 20μs/DIV.

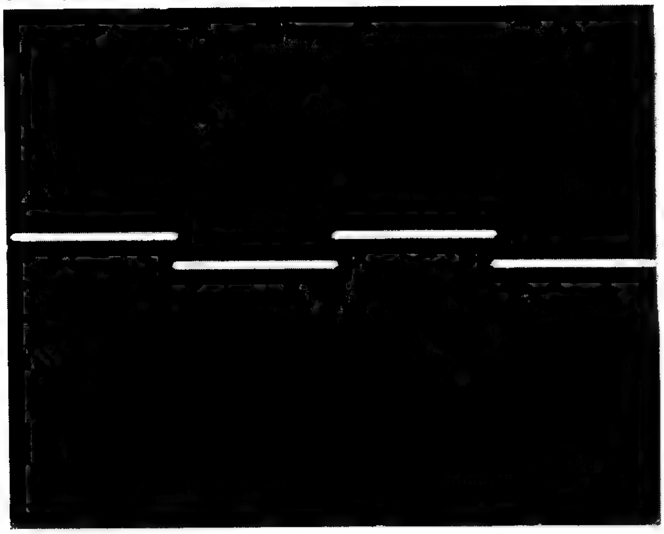


UNIT 12

T4

T6

5 mV/DIV. 20μs/DIV.

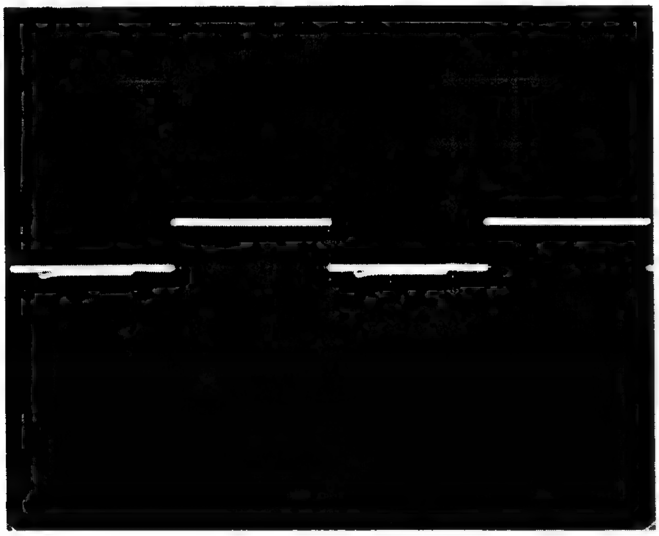


UNIT 12

T12

T17

5 mV/DIV. 20μs/DIV.

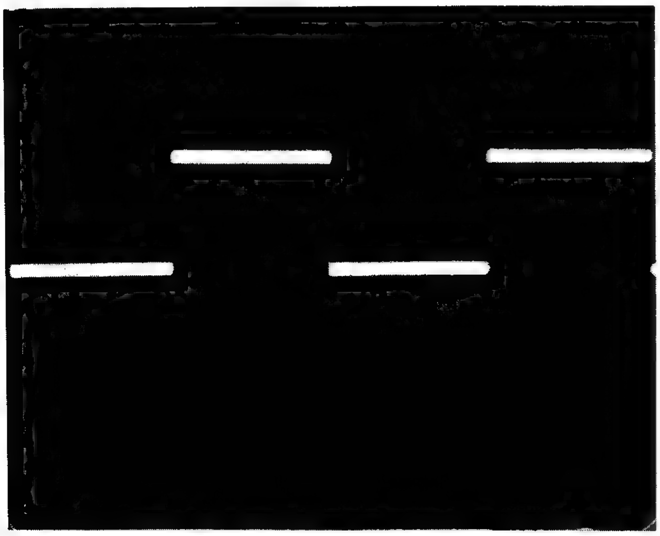


Push-button A or B of S21 or S22 depressed.

UNIT 13

T24

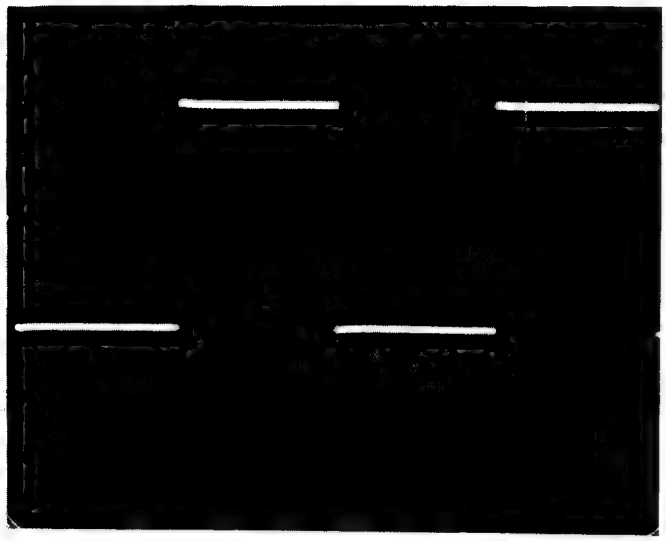
10 mV/DIV. 20μs/DIV.



10 mV/DIV. 20μs/DIV.

UNIT 13

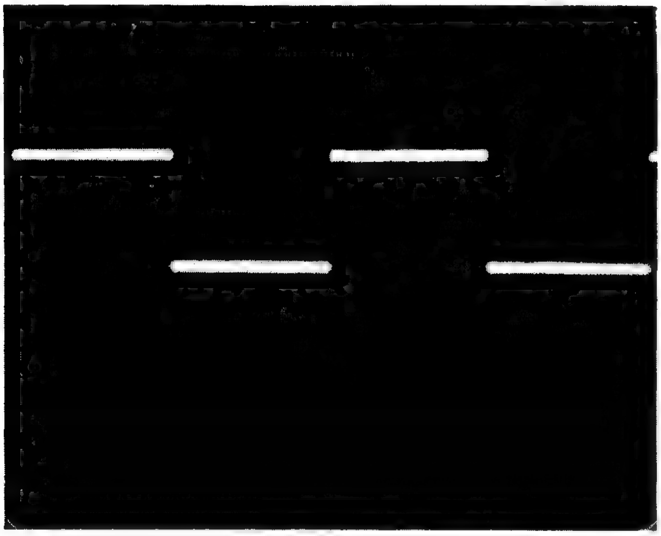
T26



10 mV/DIV. 20μs/DIV.

UNIT 13

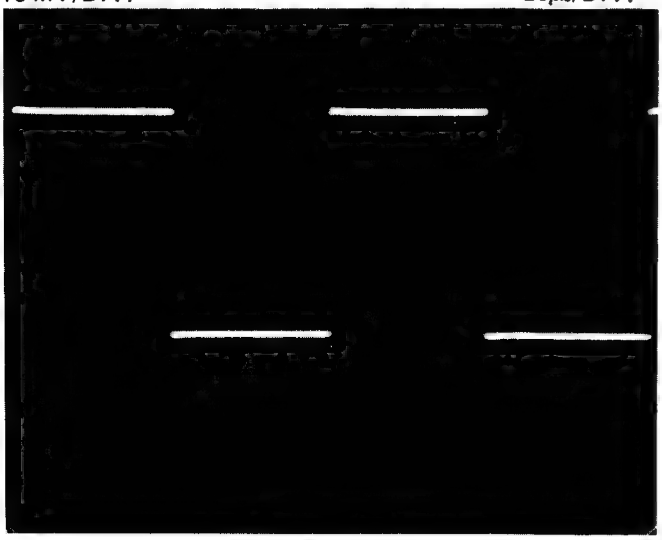
T25



10 mV/DIV. 20μs/DIV.

UNIT 13

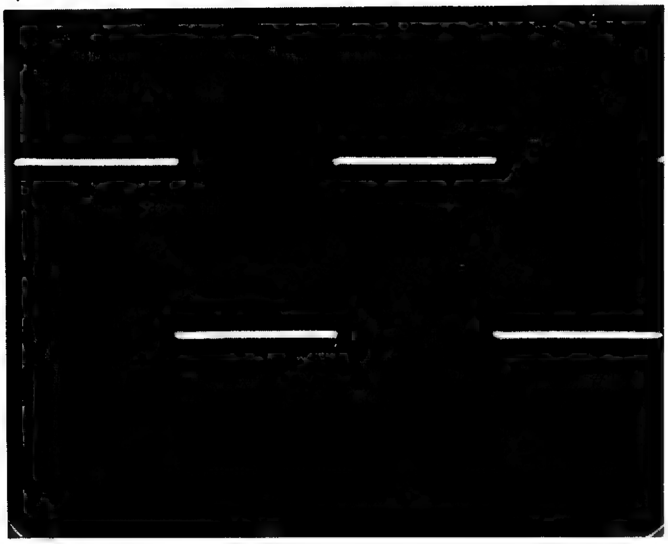
T27



UNIT 13

T28

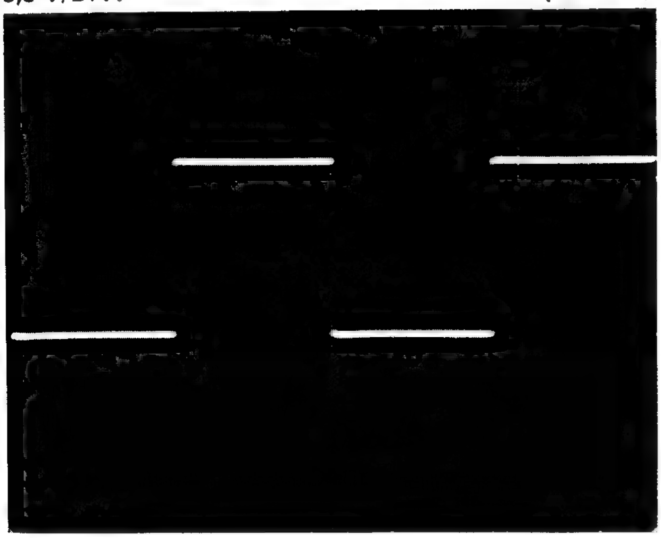
0,5 V/DIV. 20μs/DIV.



UNIT 13

T29

0,5 V/DIV. 20μs/DIV.

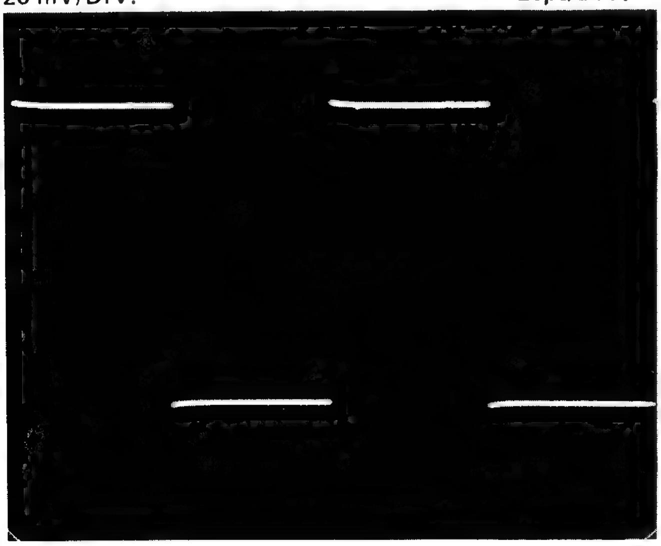


UNIT 9

TM

TD

20 mV/DIV. 20μs/DIV.



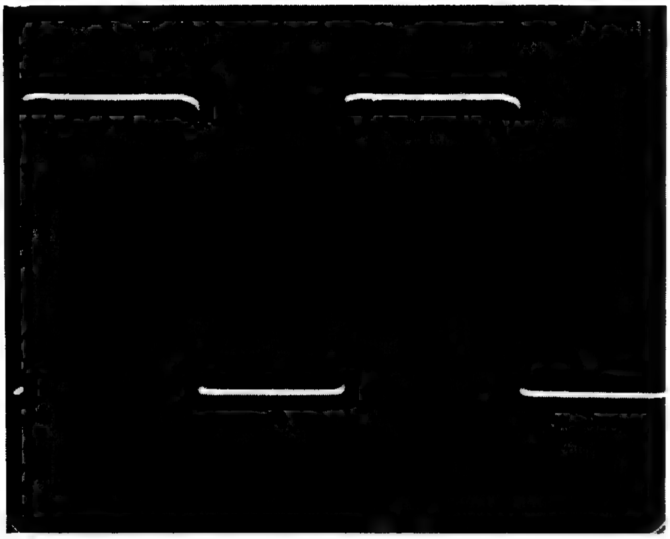
Push-button DC of S19 and S20 depressed and push-button A of S21 and S22 depressed.
M.t.b. and d.t.b. LEVEL potentiometers in their midposition (slope +).

UNIT 9

TM

TD

20 mV/DIV. 20μs/DIV.



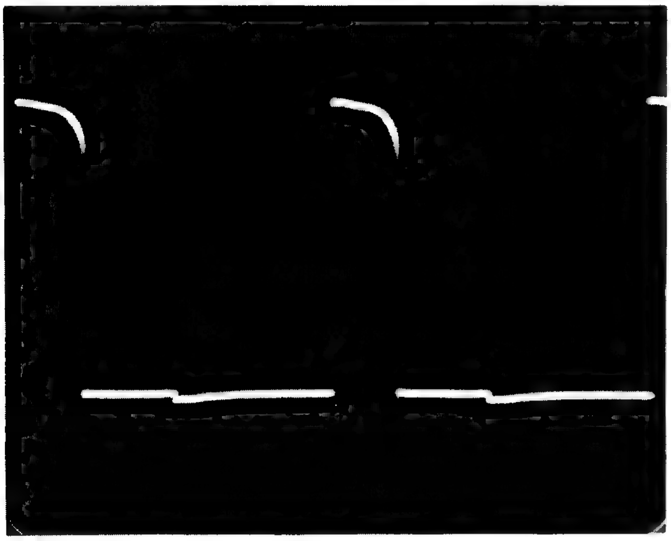
Push-button LF of S19 and S20 and push-button A of S21 and S22 depressed. M.t.b. and d.t.b. LEVEL potentiometers in their mid-position (slope +).

UNIT 9

TM

TD

20 mV/DIV. 20μs/DIV.

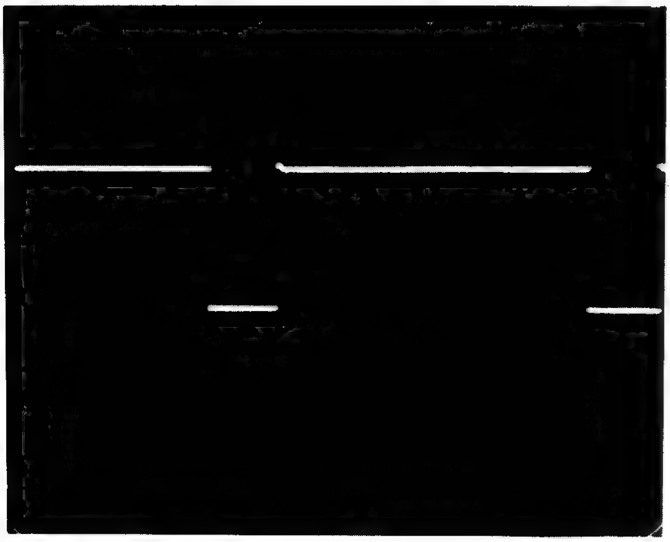


Push-button HF of S19 and S20 and push-button A of S21 and S22 depressed. M.t.b. and d.t.b. LEVEL potentiometers in their mid-position (slope +).

UNIT 8

T12

0,1 V/DIV. 50μs/DIV.



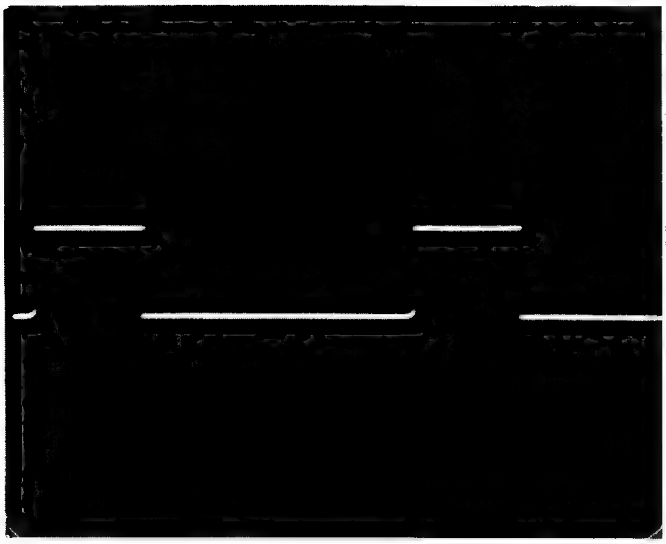
D.t.b. TIME/DIV. set to 5μs/DIV. (measured DC coupled).

0

0,1 V/DIV. 50μs/DIV.

UNIT 8

T11



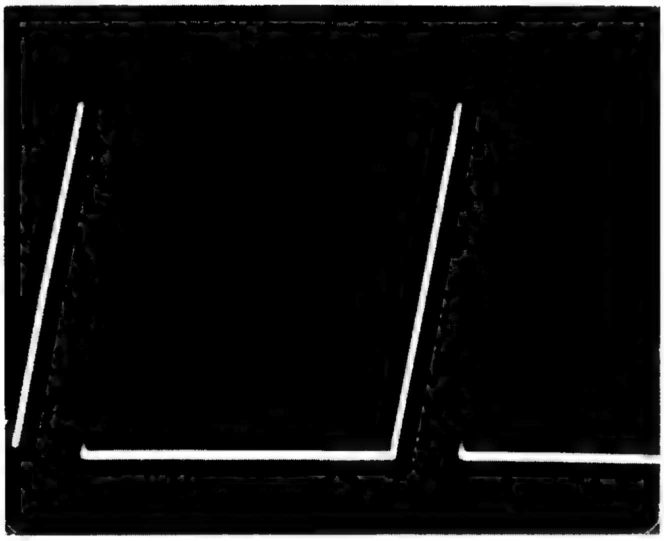
(measured DC coupled).

0

0,1 V/DIV. 50μs/DIV.

UNIT 8

T13



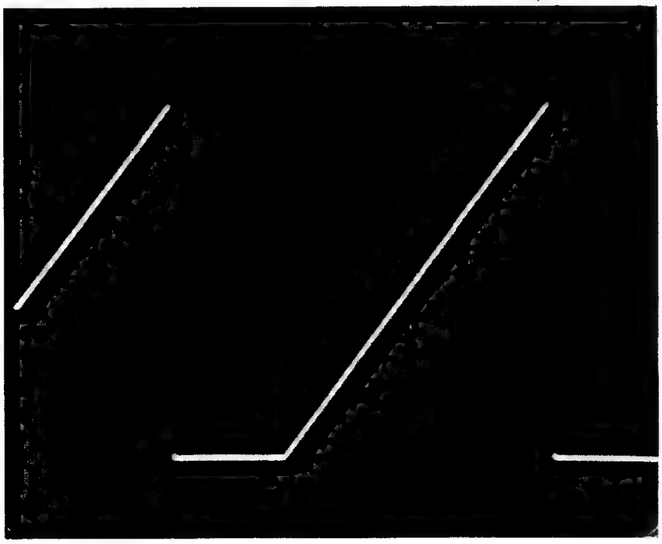
The d.t.b. TIME/DIV. switch set to 5μs/DIV.
(measured DC coupled).

0

0,1 V/DIV. 50μs/DIV.

UNIT 8

T17



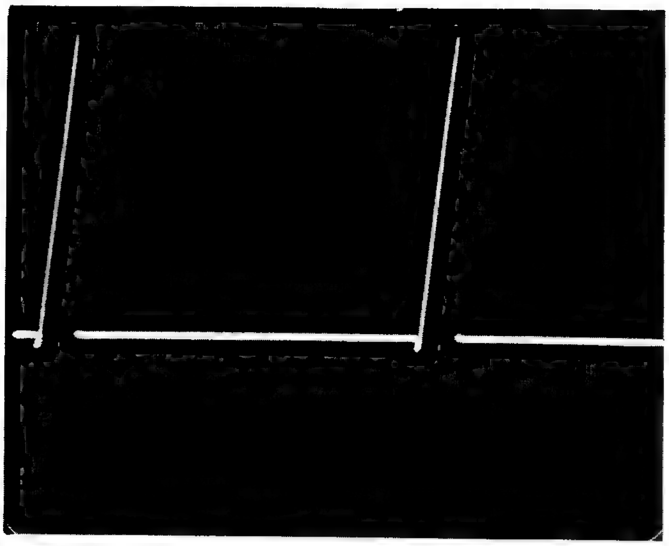
(measured DC coupled).

0

UNIT 8

T16

0,1 V/DIV. 50μs/DIV.



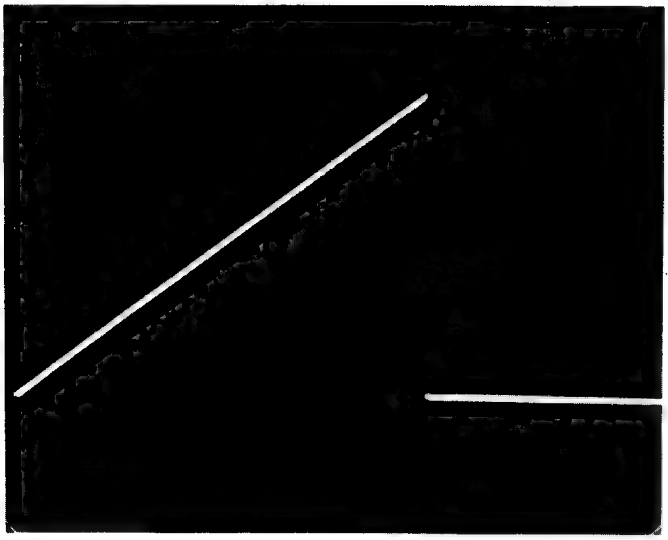
HOLD OFF potentiometer R18 to CAL.
(measured DC coupled).

0

UNIT 8

T16

0,1 V/DIV. 50μs/DIV.



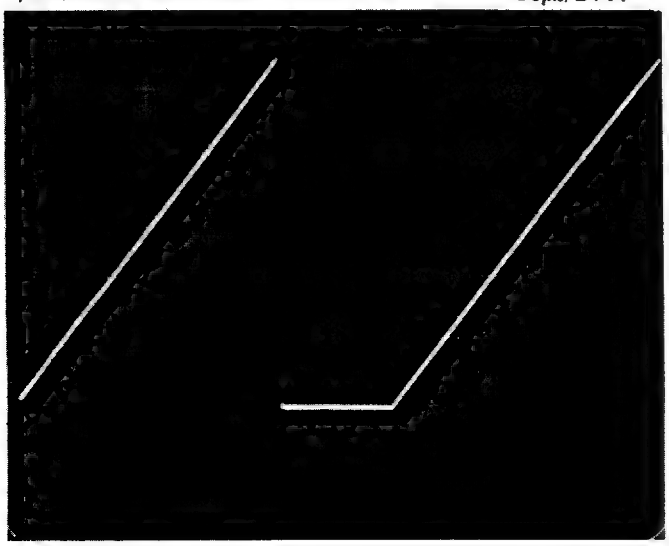
HOLD OFF potentiometer R18
fully anti clockwise.
(measured DC coupled).

0

UNIT 8

T3

0,1 V/DIV. 50μs/DIV.



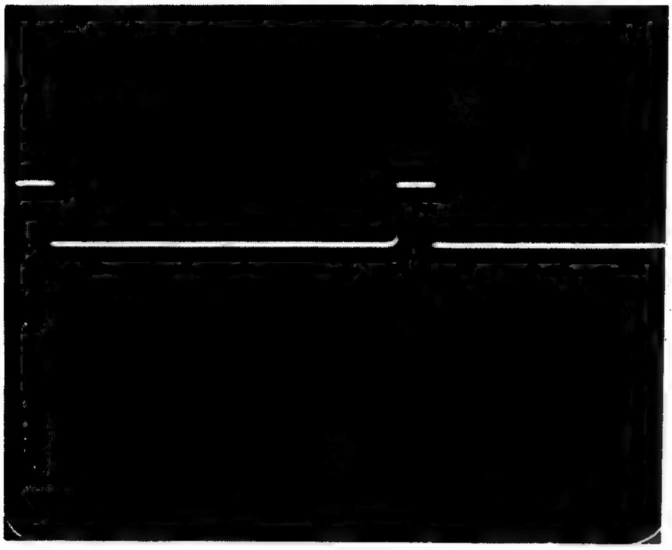
(measured DC coupled).

0

0,1 V/DIV. 50μs/DIV.

UNIT 8

T15



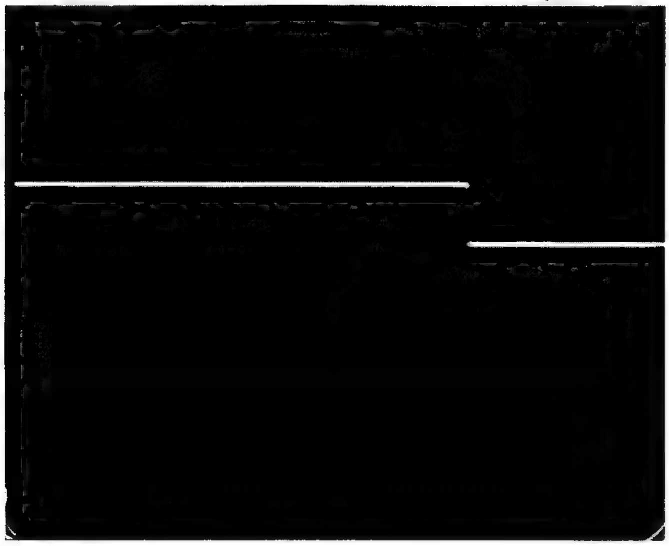
HOLD OFF potentiometer R18 to CAL.
(measured DC coupled).

0

0,1 V/DIV. 50μs/DIV.

UNIT 8

T15



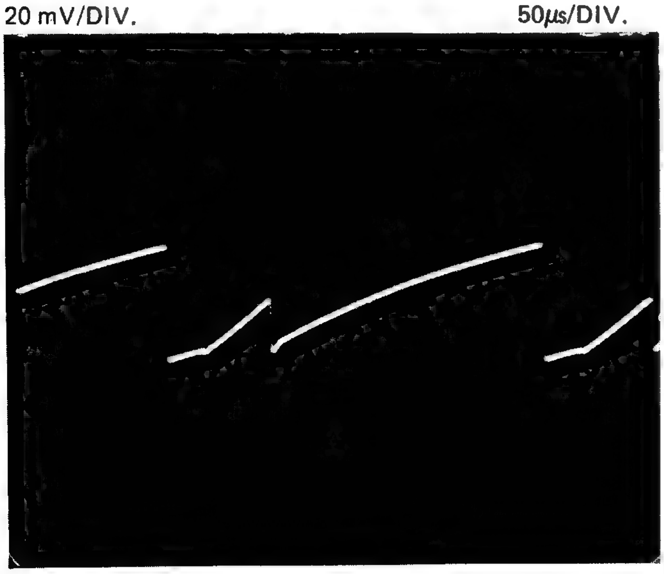
HOLD OFF potentiometer R18
fully anti clockwise.
(measured DC coupled).

0

20 mV/DIV. 50μs/DIV.

UNIT 8

T8



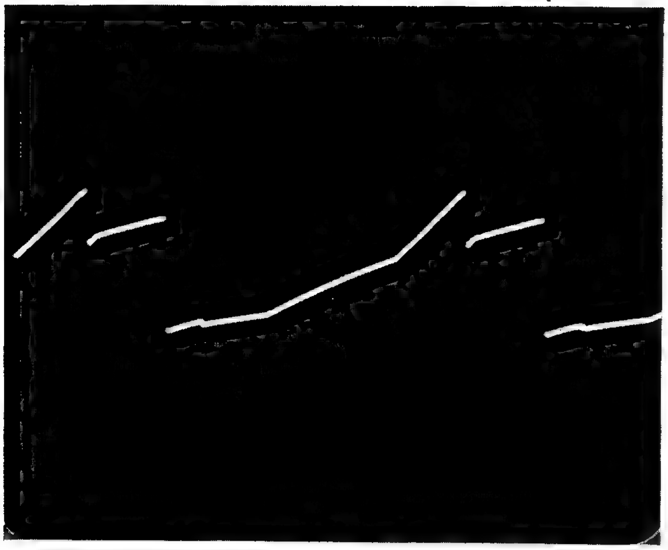
- d.t.b. TIME/DIV. switch to 5μs/DIV.
- DELAY TIME multiplier R1 to 0.
- push-button MAIN TB of S21 depressed.
  (measured DC coupled).

0

UNIT 8

T8

20 mV/DIV. 50μs/DIV.



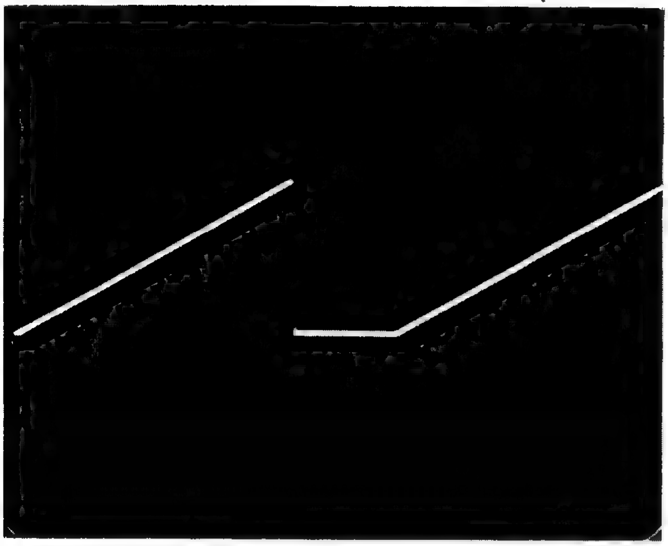
- d.t.b. TIME/DIV. switch to 5μs/DIV.
- DELAY TIME multiplier R1 to 5.
- push-button MAIN TB of S21 depressed. (measured DC coupled).

0

UNIT 8

T18

2 V/DIV. 50μs/DIV.



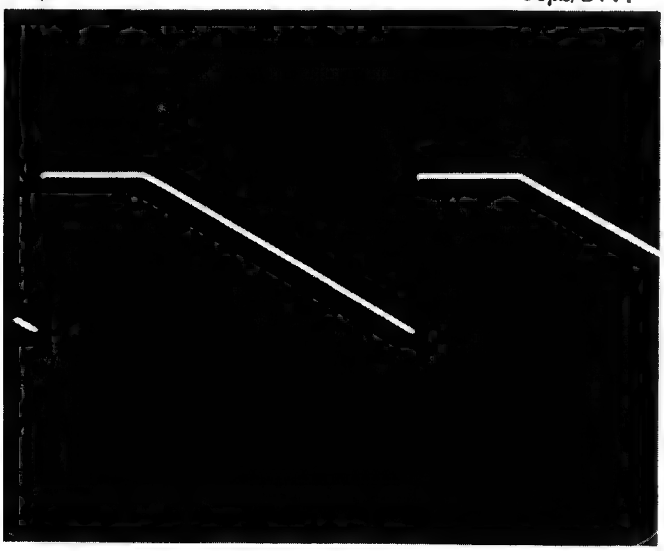
(measured DC coupled)

0

UNIT 8

T19

2 V/DIV. 50μs/DIV.



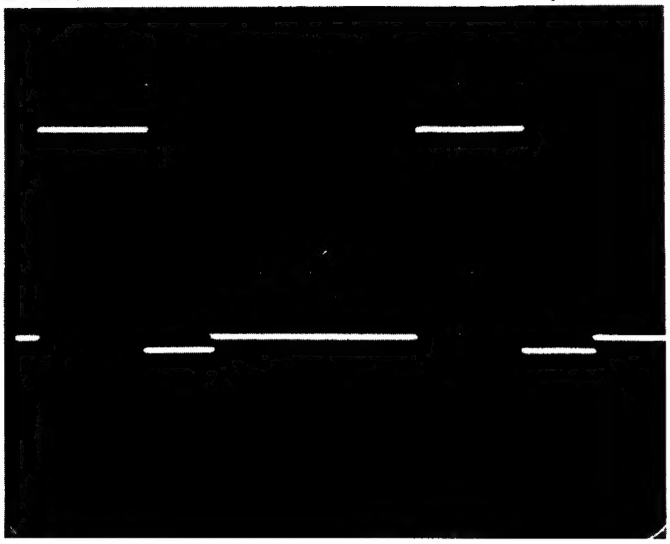
(measured DC coupled).

0

UNIT 11

T1

50 mV/DIV. 50μs/DIV.



- push-button MAIN TB of S21 depressed.
- d.t.b. TIME/DIV. switch to 5μs/DIV.
- DELAY TIME multiplier set to 0.
  (measured DC coupled).

↑ intensity control anti-clockwise.

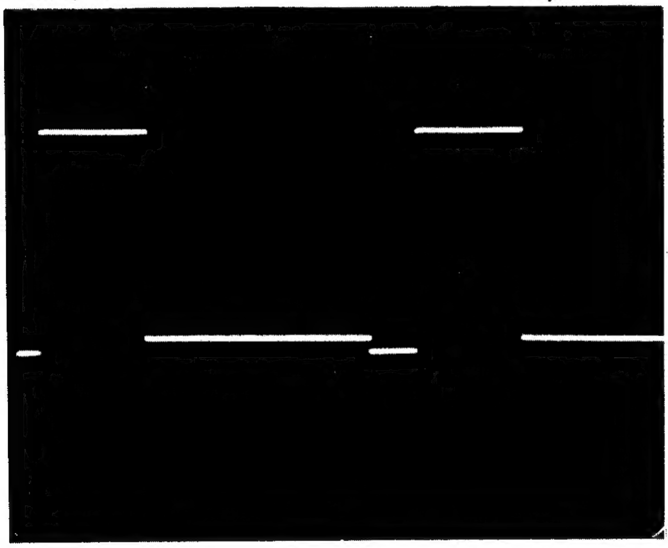
↓ intensity control clockwise.

0

UNIT 11

T1

50 mV/DIV. 50μs/DIV.



- push-button MAIN TB of S21 depressed.
- d.t.b. TIME/DIV. switch to 5μs/DIV.
- DELAY TIME multiplier set to 9.
  (measured DC coupled).

↑ intensity control anti-clockwise.

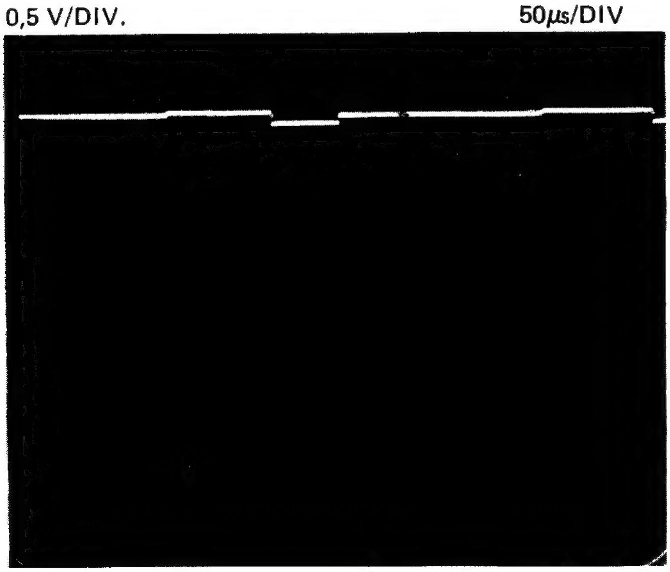
↓ intensity control clockwise.

0

UNIT 11

T3

0,5 V/DIV. 50μs/DIV



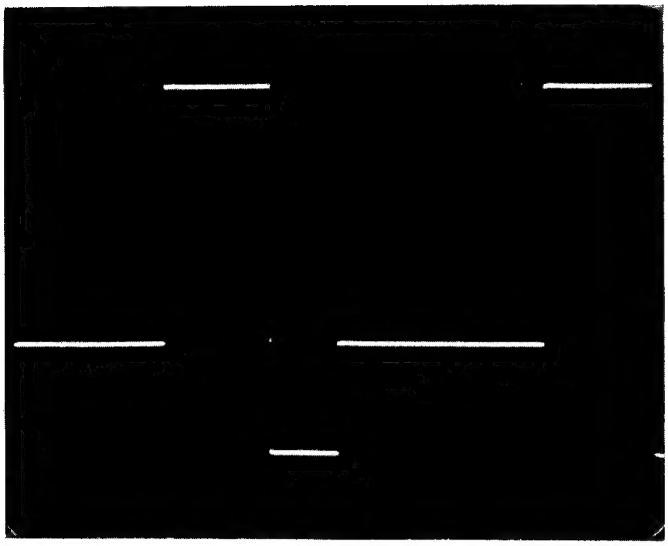
- push-button MAIN TB of S21 depressed.
- d.t.b. TIME/DIV. switch to 5μs/DIV.
- DELAY TIME multiplier to 0.
- set the intensity control fully anti-clockwise.
  (measured DC coupled).

0

UNIT 11

T3

0,5 V/DIV. 50μs/DIV.



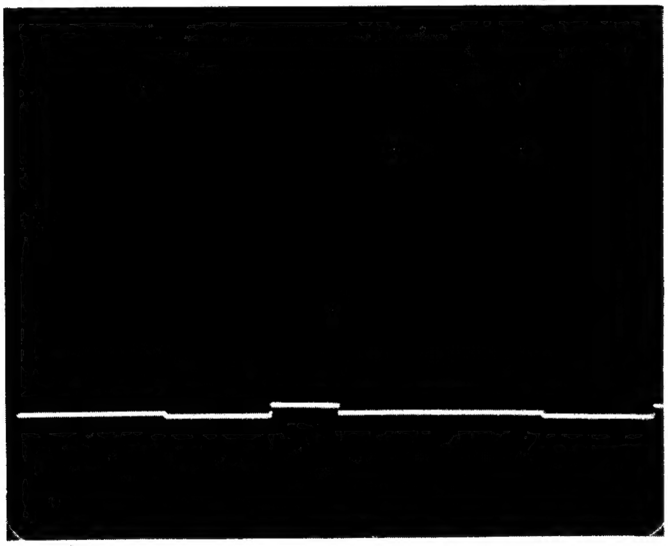
0

- push-button MAIN TB of S21 depressed.
- d.t.b. TIME/DIV. switch to 5μs/DIV.
- DELAY TIME multiplier to 0.
- set the intensity control fully clockwise. (measured DC coupled).

UNIT 11

T2

1 V/DIV. 50μs/DIV.



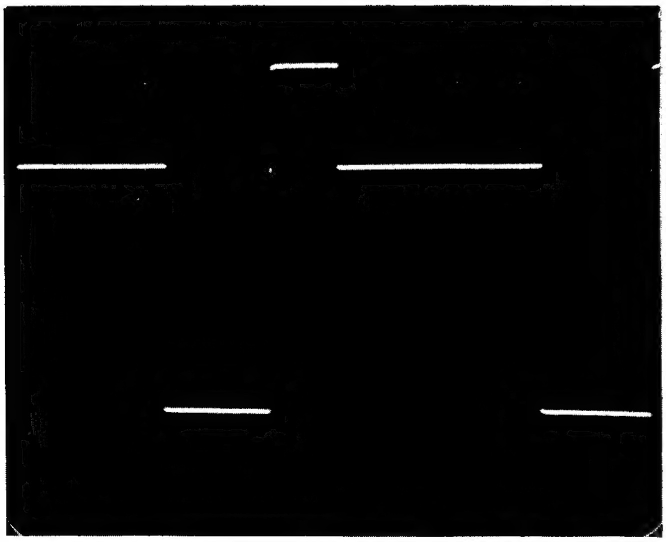
0

- push-button MAIN TB of S21 depressed.
- d.t.b. TIME/DIV. switch to 5μs/DIV.
- DELAY TIME multiplier to 0.
- set the intensity control fully anti-clockwise. (measured DC coupled).

UNIT 11

T2

1 V/DIV. 50μs/DIV.



0

- push-button MAIN TB of S21 depressed.
- d.t.b. TIME/DIV. switch to 5μs/DIV.
- DELAY TIME multiplier to 0.
- set the intensity control fully clockwise. (measured DC coupled).

CODING SYSTEM OF FAILURE REPORTING FOR QUALITY ASSESSMENT OF T & M INSTRUMENTS
(excl. potentiometric recorders)

The information contents of the coded failure description is necessary for our computerized processing of quality data.

Since the reporting of repair and maintenance routines must be complete and exact, we give you an example of a correctly filled-out PHILIPS SERVICE Job sheet.

① Country	② Day Month Year	③ Typenumber /Version	④ Factory/Serial no.
3 2	1 5 0 4 7 5	0 P M 3 2 6 0 0 2	D 0 0 0 7 8 3

CODED FAILURE DESCRIPTION ⑥

⑤ *Nature of call*	*Location*	*Component/sequence no.*	*Category*
☐ Installation		T S 0 6 0 7	5
☐ Pre sale repair		R 0 0 6 3 1	2
☐ Preventive maintenance	0 0 2 1	9 9 0 0 0 1	4
☒ Corrective maintenance			
☐ Other			

⑦ *Job completed* ☒

Working time ⑧ 1 2 Hrs

Detailed description of the information to be entered in the various boxes:

①Country: 3 2 = Switzerland

②Day Month Year 1 5 0 4 7 5 = 15 April 1975

③Type number/Version 0 P M 3 2 6 0 0 2 = Oscilloscope PM 3260, version 02 (in later oscilloscopes this number is placed in front of the serial no)

④Factory/Serial number D 0 0 0 7 8 3 = DO 783 These data are mentioned on the type plate of the instrument

⑤Nature of call: Enter a cross in the relevant box

⑥Coded failure description

Location

☐☐☐☐

These four boxes are used to isolate the problem area. Write the code of the part in which the fault occurs, e.g. unit no or mechanical item no of this part (refer to 'PARTS LISTS' in the manual).

Example: 0001 for Unit 1
000A for Unit A
0075 for item 75

If units are not numbered, do not fill in the four boxes; see Example Job sheet.

Component/sequence no.

☐☐☐☐☐☐

These six boxes are intended to pinpoint the faulty component.

A. Enter the component designation as used in the circuit diagram. If the designation is alfa-numeric, the letters must be written (starting from the left) in the two left-hand boxes and the figures must be written (in such a way that the last digit occupies the right-most box) in the four right-hand boxes.

B. Parts not identified in the circuit diagram:

990000 Unknown/Not applicable
990001 Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002 Knob (incl. dial knob, cap, etc.)
990003 Probe (only if attached to instrument)
990004 Leads and associated plugs
990005 Holder (valve, transistor, fuse, board, etc.)
990006 Complete unit (p.w. board, h.t. unit, etc.)
990007 Accessory (only those without type number)
990008 Documentation (manual, supplement, etc.)
990009 Foreign object
990099 Miscellaneous

Category

☐

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement (of transistor, resistor, etc.)
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

⑦Job completed: Enter a cross when the job has been completed.

⑧Working time: Enter the total number of working hours spent in connection with the job (excluding travelling, waiting time, etc.), using the last box for tenths of hours.

☐☐ 1 2 = 1,2 working hours (1 h 12 min.)

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